

Clinical Trial Protocol: HGT-FIR-086

Study Title: A Multicenter, Open-Label, Non-Randomized Study to Assess the Pharmacokinetics, Tolerability, and Safety of a Single Subcutaneous Administration of Icatibant in Children and Adolescents with Hereditary Angioedema

Study Number: HGT-FIR-086

Study Phase: III

Product Name: Icatibant (Firazyr[®])

Indication: Hereditary angioedema

Investigators: Multicenter

Sponsor: Shire Orphan Therapies, Inc.

Sponsor Contact: 300 Shire Way
Lexington, MA 02421 USA
PPD [REDACTED]

Medical Monitor: PPD [REDACTED] MD, PhD
Shire Human Genetic Therapies (HGT), Inc.
Mobile: PPD [REDACTED]

	Date
Original Protocol:	14 June 2011
Amendment 1	05 August 2011
Amendment 2	06 March 2012

Confidentiality Statement

This document is the proprietary and confidential property of
Shire Human Genetic Therapies, Inc.

SYNOPSIS

Sponsor:

Shire Orphan Therapies, Inc.

Name of Finished Product:

Icatibant (Firazyr®)

Study Title:

A Multicenter, Open-Label, Non-Randomized Study to Assess the Pharmacokinetics, Tolerability, and Safety of a Single Subcutaneous Administration of Icatibant in Children and Adolescents with Hereditary Angioedema

Study Number:

HGT-FIR-086

Study Phase: III

Investigational Product; Dose; and Mode of Administration:

Single dose of icatibant 0.4 mg/kg subcutaneous (SC) up to a maximal dose of 30 mg

Comparator; Dose; and Mode of Administration:

Not applicable

Study Objectives:

The objectives of this study are:

- To investigate the pharmacokinetics (PK), tolerability, and safety of a single subcutaneous (SC) dose of icatibant in children and adolescents with hereditary angioedema (HAE) during an acute HAE attack.
- To evaluate the efficacy of a single SC dose of icatibant in children and adolescents with HAE.
- To evaluate the effects on reproductive hormone levels after a single SC dose of icatibant in children and adolescents with HAE.

Other objectives of this study are:

- To evaluate the continued safety of icatibant in pubertal/postpubertal children after repeated exposures.
- To evaluate the effects on reproductive hormone levels in pubertal/postpubertal children after repeated exposures.
- To evaluate the efficacy of icatibant in the treatment of acute HAE attacks in pubertal/postpubertal children after repeated exposures.

Study Endpoints:

The primary endpoints of this study are:

- The PK profile of icatibant after a single SC injection in pediatric subjects treated for acute attacks of HAE.

- The tolerability and safety of SC icatibant as assessed by injection site reactions, adverse events, vital signs, electrocardiogram (ECG) recordings, physical examination, clinical laboratory parameters (serum chemistry [including liver function tests], hematology, urinalysis), reproductive hormone levels, and immunogenicity (anti-icatibant antibodies).

The secondary endpoints of this study are:

- For all subjects (2 to 17 years of age): investigator assessment and scoring of cutaneous, abdominal, and laryngeal symptoms of acute HAE attacks by an investigator-rated symptom score.
 - The time to onset of relief of symptoms, defined as the earliest time at which a 20% improvement is seen in the average post-treatment score with no worsening of any single component score.
 - The time to minimal symptoms, defined as the earliest time post treatment when all symptoms are either mild or absent based on the investigator-rated symptom score.
- For subjects ≥ 4 years of age only: subject self-assessment of HAE-related pain using the Faces Pain Scale-Revised (FPS-R).
 - The time to onset of relief of symptoms, defined as the earliest time at which a 20% improvement is seen in the post-treatment score.
- For subjects < 4 years of age only: investigator assessment of HAE-related pain (cutaneous, abdominal, and laryngeal) using the Faces, Legs, Activity, Cry, and Consolability (FLACC) scale.
 - The time to onset of relief of symptoms, defined as the earliest time at which a 20% improvement is seen in the total post-treatment score.
- The incidence of rescue medication use.
- The proportion of subjects with worsened intensity of clinical HAE symptoms between 2 and 4 hours after treatment with SC icatibant using investigator-rated symptom scores.

Study Design:

This is an open-label, non-randomized, single-arm study to evaluate the PK, tolerability, and safety, including effect on reproductive hormones, of a single SC administration of icatibant in pediatric subjects with HAE during an initial acute attack.

The study will enroll children and adolescents from 2 to 17 years of age who present with cutaneous, abdominal, or laryngeal symptoms of an acute HAE attack after a qualifying screening period. Subject enrollment will be stratified into 2 groups based on pubertal status: (i) a prepubertal group (defined as Tanner stage I) and (ii) a pubertal/postpubertal group (defined as Tanner stages II to V). A subject's classification as prepubertal or pubertal/postpubertal will be determined at the time of the first icatibant-treated HAE attack. Subjects classified as pubertal/postpubertal at screening will not require further evaluation of pubertal status during the study, whereas subjects classified as prepubertal at screening will have their pubertal status reassessed at the time of their first icatibant-treated HAE attack visit.

Initially, enrollment and dosing of pubertal/postpubertal subjects will precede that of prepubertal subjects. After the first 4 subjects in the pubertal/postpubertal group have been treated, icatibant PK, safety, tolerability and efficacy data will be reviewed by an independent Data and Safety Monitoring Board (DSMB). The DSMB review of the first 4 subjects shall be completed prior to continuing enrollment of additional pubertal/postpubertal subjects, icatibant treatment of second and third HAE attacks in pubertal/postpubertal subjects, and initiating enrollment of subjects in the prepubertal group.

Subjects will receive treatment with a single SC administration of icatibant on Day 1. Subjects will be monitored closely in the hospital/study center for at least 6 to 8 hours after treatment and will undergo PK, safety, and efficacy assessments. Subjects will also have serum reproductive hormone measurements. A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score must be zero, denoting the absence of symptoms). If HAE symptoms have not completely resolved at 6 hours (ie, the investigator-rated symptom score is >0), the subject shall remain in the hospital/study center for at least 8 hours after icatibant administration for further evaluation.

Safety follow-up to assess the subject's condition must be conducted at 24 and 48 hours after icatibant injection, and will occur either by telephone call from study personnel or in person at the investigator's discretion. Subjects will return to the hospital/study center for scheduled assessments on Day 8 and for a follow-up visit on Day 90.

Pubertal/postpubertal subjects may be offered further open-label treatment with icatibant contingent upon having been treated for an initial attack and presenting with a subsequent acute cutaneous, abdominal, or laryngeal attack of HAE at least 7 days after prior treatment. Open-label treatment will continue until at least 15 pubertal/postpubertal subjects have been treated with icatibant for a total of 3 attacks each. Tolerability and safety assessments, including reproductive hormone measurements, will be performed at each subsequent icatibant-treated attack as for the initial treated attack.

The investigator will schedule a telephone contact approximately 6 months after Day 1 of each icatibant-treated attack to obtain specific updates concerning pubertal changes/milestones.

Study Population:

The study will enroll a sufficient number of children and adolescents to ensure study completion of 36 evaluable subjects. The study population will consist of subjects from 2 through 17 years of age who present with an acute cutaneous, abdominal, or laryngeal HAE attack, at least 16 of whom were prepubertal at the time of their first icatibant treated HAE attack and 20 of whom were pubertal/postpubertal at the time of their first icatibant treated HAE attack.

Study Inclusion and Exclusion Criteria:

Subjects must meet all of the following criteria to be considered eligible for enrollment:

1. Two through 17 years of age, inclusive (ie, from the second birthday through the day prior to the eighteenth birthday) at the time of the subject's first HAE attack treated with icatibant as part of this study.

2. Documented diagnosis of HAE type I or II. Diagnosis must be confirmed by documented C1-INH deficiency (C1-INH protein level below the lower limit of normal and/or functional level <50% of normal). Diagnosis may be on the basis of historic data or by diagnostic testing conducted at the time of screening. Inclusion will be permitted initially based on medical history only if a clear diagnosis has been made based on all of the following criteria:
 - Family history
 - Characteristic attack manifestations, recurrent attacks
 - Historical C1-INH deficiency as demonstrated by immunologic or functional test results
 - Exclusion of other forms of angioedema
 - Subsequent confirmation of the diagnosis to be made on the basis of C1-INH level or function (all subjects)
3. Informed consent (and subject assent as appropriate) signed by the subject's parent(s) or legal guardian(s).

Subjects will be excluded from the study if there is evidence of any of the following criteria at screening or at any time prior to the time of the first attack:

1. Diagnosis of angioedema other than HAE.
2. Participation in another clinical trial that involves use of any investigational product (drug or device) within 30 days prior to study enrollment or at any time during the study.
3. Any known factor/disease that might interfere with the treatment compliance, study conduct, or result interpretation.
4. Congenital or acquired cardiac anomalies that interfere significantly with cardiac function.
5. Treatment with angiotensin converting enzyme (ACE) inhibitors within 7 days prior to treatment.
6. Use of hormonal contraception within the 90 days prior to treatment.
7. Androgen use (eg, stanozolol, danazol, oxandrolone, methyltestosterone, testosterone within the 90 days prior to treatment).
8. Pregnancy or breastfeeding.
9. A physical condition that interferes with pubertal status determination.

Study Duration:

Once eligibility is established at screening, the subject will be enrolled but will enter a period of inactive participation of variable duration until such time as the subject experiences an acute attack of HAE and is offered treatment. At that time, the subject will enter a 90-day period of active participation which will consist of treatment with a single SC administration of icatibant on Day 1 through follow-up at Day 90. After receiving treatment for an initial attack of acute HAE, at least 15 pubertal/postpubertal subjects who present with subsequent attacks of acute HAE will continue to receive treatment with icatibant for a total of 3 attacks each.

Thus, the period of active participation in the study for prepubertal subjects will be approximately 90 days, while that for pubertal/postpubertal subjects will be a maximum of approximately 270 days (3 separate active periods of approximately 90 days), with each

active period separated by periods of inactive participation of variable duration. The period of active participation may be shorter if pubertal/postpubertal subjects have recurrent HAE attacks in between the Day 8 and Day 90 visits for a prior icatibant-treated HAE attack. Telephone follow-up will occur approximately 6 months after each icatibant-treated attack.

Once the sixteenth prepubertal subject and the twentieth pubertal/postpubertal subject have completed the 6-month follow-up after treatment for an initial attack, and the fifteenth pubertal/postpubertal subject has completed the 6-month follow-up after his or her third and final treatment, the study will be closed.

The approximate overall duration of the study is expected to be 3 years.

Pharmacokinetic Variables:

PK variables will be determined by full sampling and noncompartmental methods where possible, and elsewhere by sparse sampling (at least 4 to 7 time points) and a population PK approach using non-linear mixed effects modeling software.

PK parameter estimates will include, where appropriate: actual icatibant and metabolite concentrations at each sampling time, time to peak concentration (T_{max}), actual peak (C_{max}) and minimum (C_{min}) concentrations, clearance (CL/F), actual area under the plasma concentration-time curve (AUC_{0-last} and AUC_{0-inf}), mean residence time (MRT), volume of distribution at steady state (V_{ss}/F) and elimination half-life ($t_{1/2}$).

Safety Assessments:

Safety will be assessed by standard criteria including physical examination, vital signs, ECGs, clinical laboratory evaluations (clinical chemistry [including liver function tests], hematology, urinalysis), and immunogenicity (presence of anti-icatibant antibodies), recording of concomitant medications, and monitoring of adverse events. Local tolerability will be assessed by evaluation of reactions at the site of icatibant administration (injection site). Levels of reproductive hormones will be assessed in female (follicle stimulating hormone [FSH], luteinizing hormone [LH], estradiol, progesterone) and male (FSH, LH, testosterone) subjects.

Efficacy Assessments:

Efficacy will be assessed using both investigator- and subject-reported outcomes, depending on the subject's age. Investigators will assess and score symptoms of acute cutaneous, abdominal, and laryngeal attacks of HAE for all subjects using an investigator-rated symptom score. Subjects who are 4 years of age or older will perform a self-assessment of HAE-related pain using the FPS-R instrument. Subjects who are younger than 4 years of age will have symptoms assessed by the investigator only; including an assessment of HAE-related pain (cutaneous, abdominal, and laryngeal) using the FLACC scale. The time of initial symptom relief as assessed by the investigator will be recorded for all subjects.

Statistical Methods:

Summary statistics for continuous variables will include the number of subjects, the mean, median, standard deviation, and range. For PK parameters, the coefficient of variation and geometric mean also will be provided.

For categorical data, summaries will include counts and percentages. For time-to-event data, the median time to event and other summary statistics will be estimated using

Kaplan-Meier methodology.

The following populations will be used in the analysis:

- The Initial Non-laryngeal Treatment Population will consist of those subjects who were treated with icatibant for their initial attack and whose primary symptom was either cutaneous or abdominal.
- The Second Non-laryngeal Treatment Population will consist of those subjects who had a second icatibant-treated attack for which the primary symptom was either cutaneous or abdominal, regardless of the primary symptom for the initial attack.
- The Third Non-laryngeal Treatment Population will consist of those subjects who had a third icatibant-treated attack, for which the primary symptom was either cutaneous or abdominal, regardless of the primary symptom for the initial attack.
- The Laryngeal Population will consist of those subjects who were treated with icatibant for any attack for which the primary symptom was laryngeal.
- The PK Population will consist of those subjects who were treated with icatibant for their initial attack and who had at least 1 post-treatment icatibant concentration recorded.
- The Initial Treatment Population will consist of those subjects who were treated with icatibant for the initial attack. Safety and tolerability analyses will use this population.
- The Additional Treatment Population will consist of those pubertal/post-pubertal subjects who were treated with icatibant for more than 1 attack. Safety and tolerability analyses will use this population.

Subject disposition, demographic and baseline characteristics, medical history, and use of concomitant medications will be summarized for each analysis population.

Efficacy endpoints, including change from baseline when appropriate, will be summarized descriptively for the Initial, Second, and Third Non-laryngeal Treatment Populations. The primary efficacy endpoint is the time to onset of symptom relief measured using the investigator-rated symptom score. Time of symptom relief is defined as the earliest time post treatment at which there is a 20% improvement in the average post-treatment symptom score with no worsening of any single component score. The efficacy data associated with the laryngeal attacks will be provided in data listings for the Laryngeal Population.

Plasma concentrations of icatibant by time point and the PK parameters will be summarized descriptively.

The assessment of safety will be based mainly on the frequency of adverse events. Adverse events will be summarized by presenting the number and percentage of subjects having any adverse event, having an adverse event in each body system, and having each individual adverse event using the Medical Dictionary for Regulatory Activity (MedDRA). Adverse events also will be tabulated by severity and relationship to

treatment.

Local tolerability will include symptoms at the injection site and will be assessed separately from general reports of adverse events. Local tolerability will be tabulated and summarized according to the type and severity of attack.

The change from baseline in the secretion of reproductive hormones and the change from baseline in HAE symptoms (as reported by the investigator or subject) will be summarized descriptively.

Date of Amended Protocol: 06 March 2012

6.6	Concomitant Medication Usage.....	30
6.7	Rescue Therapy.....	30
6.8	Restrictions	31
6.8.1	Fluid and Food Intake	31
6.8.2	Subject Activity Restrictions	31
6.9	Treatment Compliance.....	31
6.10	Packaging and Labeling.....	31
6.11	Storage and Accountability.....	32
6.12	Investigational Product Retention at Study Site	32
7	STUDY PROCEDURES	33
7.1	Informed Consent.....	33
7.2	Study Entrance Criteria.....	33
7.3	Confirmation of Study Eligibility	33
7.4	Demographics	33
7.5	Medical History	33
7.6	Menstrual Cycle History	34
7.7	Height and Weight	34
7.8	Pubertal Status Determination	34
7.9	Investigational Product Administration	34
7.10	Pharmacokinetic Assessments	35
7.10.1	Pharmacokinetic Variables	35
7.10.2	Pharmacokinetic Sampling	35
7.10.3	Bioanalytical Method.....	35
7.11	Efficacy Assessments.....	35
7.11.1	Investigator Symptom Score.....	35
7.11.2	Subject Self-assessment of Pain.....	36
7.11.3	Investigator Assessment of Pain.....	36
7.11.4	Initial Symptom Relief.....	36
7.12	Reproductive Hormone Assessments	36
7.13	Safety Assessments.....	37
7.13.1	Physical Examination.....	37
7.13.2	Vital Signs.....	37
7.13.3	Electrocardiography	37
7.13.4	Clinical Laboratory Tests.....	37
7.13.5	Local Tolerability.....	38
7.13.6	Immunogenicity	38
7.13.7	Pregnancy Testing.....	39
7.14	Sample Collection, Storage, and Shipping	39

7.15	Recording of Concomitant Medications	39
7.16	Recording of Adverse Events	39
7.17	Adverse Events Assessments	39
7.17.1	Definitions of Adverse Events and Serious Adverse Events	39
7.17.2	Classification of Adverse Events and Serious Adverse Events	41
7.17.3	Relatedness of Adverse Events and Serious Adverse Events	42
7.17.4	Procedures for Recording and Reporting Adverse Events	42
7.18	Pregnancy	44
7.19	Abuse, Overdose, and Medication Error	44
7.20	Removal of Subjects from the Trial or Investigational Product	45
7.20.1	Safety-Related Study Stopping Rules	45
7.21	Appropriateness of Measurements	46
8	STUDY ACTIVITIES	48
8.1	Screening (Day of Informed Consent to Pretreatment on Day 1 of the Initial H_____dg	
8.2	Pretreatment (Baseline) Assessments (Day 1, Initial and Subsequent Attacks)	48
8.3	Initial Attack	49
8.3.1	Treatment Period (Day 1 to Day 8 [± 1 Day])	49
8.3.2	Follow-up Visit (Day 90 ±7 days)	50
8.3.3	Telephone Contact (Month 6 ±7 days)	50
8.4	Subsequent Attacks (Pubertal/postpubertal Subjects Only)	51
8.4.1	Treatment Period (Day 1 to Day 8 [± 1 Day])	51
8.4.2	Follow-up Visit (Day 90 ±7 days)	52
8.4.3	Telephone Contact (Month 6 ±7 days)	52
9	QUALITY CONTROL AND ASSURANCE	53
r f	Y Y _____xd	
10.1	General Considerations	54
10.2	Determination of Sample Size	54
10.3	Analysis Populations	54
10.4	Demographics and Baseline Characteristics	55
10.5	Pharmacokinetic Analysis	55
10.5.1	Estimation of PK Parameters	55
10.6	Safety and Tolerability Analysis	56
10.7	Efficacy Analysis	57
10.8	Other Analyses	58
10.9	Data Monitoring and Interim Analysis	58
10.10	Handling of Missing Data	58
11	ADMINISTRATIVE CONSIDERATIONS	59

11.1	Investigators and Study Administrative Structure	59
11.2	Institutional Review Board or Independent Ethics Committee Approval	59
11.3	Ethical Conduct of the Study	59
11.4	Subject Information and Consent/Assent.....	59
11.5	Subject Confidentiality	60
11.6	Study Monitoring	61
11.7	Case Report Forms and Study Records	61
11.7.1	Critical Documents	61
11.8	Data and Safety Monitoring Board	62
11.9	Protocol Violations/Deviations.....	62
11.10	Premature Closure of the Study	63
11.11	Access to Source Documentation	63
11.12	Data Generation and Analysis	63
11.13	Retention of Data	64
11.14	Financial Disclosure.....	64
11.15	Publication and Disclosure Policy	64
12	LIST OF REFERENCES	65

LIST OF IN-TEXT TABLES

Table 4-1	Study Periods	23
Yer	Y Y Y Y _____	pg
Table 7-2	Adverse Event Severity.....	41
Table 7-3	Adverse Event Relatedness.....	42

LIST OF APPENDICES

Appendix 2	Study Schedule of Events (Subsequent Icatibant-treated Attacks)....	71
Y	Y Y Y Y _____	vd
Appendix 4	Faces Pain Scale-Revised (FPS-R)	75
Appendix 5	Faces, Legs, Activity, Cry, and Consolability Scale (FLACC)	76
Y	Y Y _____	vv
Appendix 7	Summary of Changes for Amendment 2	78

LIST OF ABBREVIATIONS AND DEFINITIONS OF TERMS

ACE	Angiotensin converting enzyme
AE	Adverse event
AUC	Area under the curve extrapolated to zero
BMI	Body mass index
BSA	Body surface area
C1-INH	C1 esterase inhibitor (human)
CFR	Code of Federal Regulations
CIOMS	Council for International Organizations of Medical Sciences
CL/F	Total body clearance
C _{max}	Maximum observed plasma concentration
C _{min}	Minimum plasma drug concentration
CRF	Case report form
CRO	Contract research organization
CYP	Cytochrome P450
DHEA	Dehydroepiandrosterone
DHEA-S	Dehydroepiandrosterone-Sulfate
DSMB	Data and Safety Monitoring Board
EC ₅₀	Half maximal effective concentration
ECG	Electrocardiogram
e-diary	Electronic diary
EMA	European Medicines Agency
FDA	United States Food and Drug Administration
FFP	Fresh frozen plasma
FLACC	Faces, Legs, Activity, Cry, and Consolability (comportmental pain scale)
FPS-R	Faces Pain Scale-Revised
FSH	Follicle stimulating hormone
GAM	General additive model
GCP	Good Clinical Practice
GFR	Glomerular filtration rate
GnRH	Gonadotrophin releasing hormone
HAE	Hereditary Angioedema
hCG	Human chorionic gonadotropin
HGT	Human Genetic Therapies

hr	Hour(s)
ICH	International Conference on Harmonization
IEC	Independent Ethics Committee
IND	Investigational New Drug Application
IRB	Institutional Review Board
IV	Intravenous(ly)
kg	Kilogram(s)
L	Liter(s)
LBW	Lean body weight
LH	Luteinizing hormone
LOCF	Last observation carried forward
MedDRA	Medical Dictionary for Regulatory Activity
mg	Milligram
min	Minute(s)
mL	Milliliter(s)
mm	Millimeters
MRT	Mean residual time
n	Number
ng	Nanogram(s)
NSAIDs	Non-steroidal anti-inflammatory drugs
PD	Pharmacodynamic
PK	Pharmacokinetic(s)
SAE	Serious adverse event
SAS	Statistical Analysis System®
SC	Subcutaneous
SHBG	Sex Hormone Binding Globulin
SOC	System organ class
$t_{1/2}$	Terminal elimination half-life
TBW	Total body weight
T_{max}	Time to maximum concentration
US	United States
VAS	Visual analog scale
V_{ss}	Volume of distribution at steady state

1 INTRODUCTION

1.1 Disease Background

Bradykinin is responsible for the clinical symptoms of hereditary angioedema (HAE), causing increased vascular permeability, vasodilation, and contraction of visceral smooth muscle. HAE is a rare autosomal dominant disorder characterized clinically by recurrent and self-limiting attacks of edema of the skin, gastrointestinal tract, and larynx. Its prevalence is estimated at 1:10,000 to 1:50,000^r

HAE is usually caused by either a quantitative (Type I) or qualitative (Type II) deficiency of C1 inhibitor. C1 inhibitor functions in several biochemical pathways, including inhibition of C1 complement auto-activation (its originally identified function which led to its name), inactivation of coagulation factors XIIa, XIIb, XIa, and inhibition of activated kallikrein. After a triggering event, the deficiency in C1 inhibitor results in accelerated release of bradykinin by its cleavage from high molecular weight kininogen by dysregulated, activated kallikrein. Bradykinin is the principal mediator of the increased vascular permeability characteristic of HAE. Type III HAE is much more rare, is not related to C1-INH protein function, and has unknown etiology; thus its pathophysiology will not be considered further here.

Icatibant is a synthetic decapeptide YY Y Y Y kinin that acts as an antagonist of the bradykinin receptor. It is highly specific for the B2 receptor, and is characterized by high potency in vitro and in vivo, and sufficient biological half-life to allow systemic administration by oral route. Inhibition of bradykinin action through use of a B2 receptor antagonist is a therapeutic strategy for treatment of clinical symptoms of HAE, and represents the rationale for use of icatibant in treatment of acute attacks of angioedema in HAE patients. In adults, SC icatibant 30 mg has been shown to produce a rapid and durable response in the treatment of cutaneous, abdominal, and laryngeal attacks of acute HAE. A single SC injection is generally sufficient for accelerated relief of symptoms of acute HAE attacks irrespective of edema location. Repeated use of icatibant over time for treatment of multiple acute HAE attacks in adults produces a consistent response at each attack, with no diminution of efficacy. When self-administered by adults experiencing an acute HAE attack, icatibant also produces a rapid and safe treatment response.

The management of HAE in pediatric patients is complex. The age at onset, the frequency and duration of symptoms, as well as the severity of attacks all exhibit substantial inter-individual variation. Although acute episodes of HAE may occur at any age, the age at onset of symptomatic HAE attack is estimated to range between 4 to 11 years (reviewed by ^h). Subcutaneous edema of the extremities, face, neck, torso, and genitals is the most common, and usually the earliest, manifestation of HAE seen in children. Two peaks of increased frequency and severity of HAE symptoms were reported in a large pediatric cohort, one peak between 3 and 6 years of age and the second at around puberty. Physiological changes which occur in these periods of development^h In the gastrointestinal tract, submucosal edema may be associated with colicky abdominal pain, nausea, vomiting, and diarrhea.

Though infrequent compared to cutaneous and abdominal manifestations, attacks of acute HAE involving the larynx may result in submucosal edema of the upper airways and risk of death by asphyxiation if undiagnosed and/or untreated. In comparison to adults asphyxia may ensue more rapidly in children because of smaller airway diameter.

Prompt control of attacks, short-term prophylaxis, "intermittent" prophylaxis, long-term prophylaxis and emergency therapy are recommended for the management of pediatric HAE.^h Treatment options for children with HAE according to current guidelines include antifibrinolytics, attenuated androgens, and C1 inhibitor (C1-INH) replacement therapy. Current guidelines favor antifibrinolytics for long-term prophylaxis because of their safety profile relative to attenuated androgens. The preferred antifibrinolytic agent, where approved for use, is tranexamic acid, though ϵ -aminocaproic acid is sometimes also used for this purpose. C1-INH replacement therapy has been used successfully for management of acute attacks of HAE in children; however, its use in children is associated with the same drawbacks (ie, requirement for intravenous [IV] administration, potential to elicit hypersensitivity reactions, possible transmission of blood-borne infectious agents) as in adults.

1.2 Previous Clinical Studies

1.2.1 Pharmacokinetics of Icatibant

The pharmacokinetic (PK) properties of icatibant have been characterized extensively in studies using both IV and SC administration to healthy adult subjects and adult subjects with HAE. The PK profile of icatibant in adults with HAE (JE049-2101) is similar to that in healthy adults.

After SC administration of a single 30 mg dose of icatibant to healthy adult subjects (N=96), a mean (\pm standard deviation) maximum plasma concentration (C_{max}) of 974 ± 280 ng/mL was observed after approximately 0.75 hours. The mean area under the concentration-time curve ($AUC_{0-\infty}$) after a single 30 mg dose was 2165 ± 568 ng•hr/mL, with no evidence of accumulation of icatibant after three 30 mg doses administered 6 hours apart.

Plasma clearance after SC administration of icatibant was 245 ± 58 mL/min with a mean elimination half-life of 1.4 ± 0.4 hours and volume of distribution at steady state (V_{ss}) of 29.0 ± 8.7 L. The information obtained from Phase III clinical studies clearly demonstrated that SC icatibant 30 mg is a clinically safe and effective treatment for attacks of acute angioedema across a wide range of subject demographics, including age, sex, and body weight.

Icatibant is extensively metabolized by proteolytic enzymes to inactive metabolites that are primarily excreted in the urine, with less than 10% of the dose eliminated as unchanged drug. Icatibant is not degraded by oxidative metabolic pathways, and is not an inhibitor of major cytochrome P450 (CYP) isoenzymes (CYP 1A2, 2A6, 2B6, 2C8, 2C9, 2C19, 2D6, 2E1, and 3A4) and is not an inducer of CYP 1A2 and 3A4.

Clinical PK studies demonstrate that for mild to moderate impairment of renal or hepatic function no dose adjustment is necessary. In 10 subjects with hepatorenal syndrome (glomerular filtration rate (GFR) 30 to 60 mL/min), clearance of icatibant was not dependent on renal

function. Icatibant clearance in subjects with a wide range of hepatic impairment (Child-Pugh score ≥ 7 and ≤ 15) was similar to that in healthy subjects.

1.2.2 Phase III Investigation of SC Icatibant

Despite the rarity of HAE, a comprehensive data set supports the efficacy and safety of SC icatibant.

In Phase I, II, and III clinical studies, SC icatibant 30 mg was administered to 129 healthy adult subjects and to 236 adult subjects with HAE. A total of 999 acute attacks of HAE were treated with icatibant administered by a health care provider, and an additional 56 attacks were treated with icatibant when self administered by patients (Integrated Summary of Safety 11 January 2011).

In integrated analyses of pooled data from 3 controlled Phase III studies (HGT-FIR-054, JE049-2102, and JE049-2103), icatibant significantly decreased the time to onset of symptom relief for cutaneous and abdominal attacks relative to comparator agents (placebo, tranexamic acid) as demonstrated by the primary and key secondary endpoint analyses in subjects with non-laryngeal symptoms randomized to double-blind treatment. Moreover, the median time to onset of symptom relief after icatibant treatment was consistent across all of the controlled Phase III studies and across the 2 endpoints, ranging from 1.5 to 2.3 hours. Likewise, icatibant showed effectiveness in the treatment of laryngeal attacks.

The recommended dose of icatibant in adults is 1 SC injection of 3 mL (30 mg) administered in the abdominal area for the treatment of acute attacks of HAE. In case of insufficient relief or recurrence of symptoms, a second injection of icatibant can be administered after 6 hours. No more than 3 injections of icatibant should be administered in a 24 hour period. In clinical trials, a single SC injection of icatibant was generally sufficient to treat an acute HAE attack. No differences in the efficacy or safety of icatibant in clinical trials have been observed between sexes; therefore, dose adjustments for adult males or females are not considered necessary.

Beyond exposure in clinical studies, it is estimated that over 13,000 patient exposures to Firazyr[®] occurred cumulatively in the postmarketing setting from the time of European Union regulatory approval in July 2008 through July 2011.

Please refer to the current edition of the Investigator's Brochure for further information concerning the safety and clinical development of icatibant.

1.2.3 Investigations of Potential Effects of Bradykinin Inhibition on Reproductive Function

In nonclinical studies performed in rat and dog, high repeated doses of icatibant have been associated with effects on sexual organs and sexual maturation. These findings are consistent with published data showing a role of bradykinin action through B2 receptors in the control of reproductive hormone release.

Potential effects of icatibant on sexual organs and sexual maturation are being investigated further in studies in juvenile rats. These are a SC administration local tolerance study, and a

7-week toxicity study with assessment of fertility. The local tolerance study in juvenile rats established the doses for the 7-week toxicity study. Briefly, in the 7-week toxicity study juvenile males and females were dosed with icatibant at 3, 9, 25 mg/kg/day during a 7-week maturation period. In males, slightly but statistically significant delayed physical maturation and lowered prostate and testes weight were seen at the mid and high doses. Small testes and epididymis were occasionally seen at the highest dose. Microscopically, tubular cell vacuolation and germ cell degeneration were seen in males in the testes at all doses. Statistically significantly decreased sperm motility, velocity, and counts at recovery were observed at the highest dose. Decreased fertility was observed in untreated females paired with treated males at the highest dose. All microscopic and organ weight findings were either completely or partially reversible. The complete results will be reported in the final study reports.

A retrospective analysis, prompted by nonclinical observations, of serum levels of gonadotrophic hormone levels (follicle-stimulating hormone [FSH] and luteinizing hormone [LH]) in 16 male and 16 female healthy volunteers in an Phase I study (JE049-1103) showed no clinically important changes from baseline in levels of FSH and LH after administration of 3 SC doses (30 mg each) of icatibant 6 hours apart on Day 1 followed by single SC doses (30 mg) on Day 8 and Day 15.

Phase 1 study (HGT-FIR-062) was a double-blind, randomized, placebo-controlled, single center study to assess the effect of icatibant on serum reproductive hormone levels in male and premenopausal female healthy adult subjects and seminal fluid analysis in healthy male adult subjects. This study was intended to definitively determine the effect of repeated administration of 3 SC doses of icatibant 30 mg on reproductive hormone levels in adults prior to any investigational use in pediatric subjects per the recommendation of the European Medicines Agency (EMA). Subjects were randomized to receive icatibant or placebo as a single SC injection at 6 hour intervals 3 times daily on Days 1, 4, and 7 of the treatment week (total 9 doses/week) with an approximately 8 week follow-up phase.

Thirty-nine adult subjects (16 females and 23 males) were enrolled and treated in Study HGT-FIR-062; 32 subjects completed the study in its entirety (7 subjects did not return for follow-up visits). No negative trends were seen with regard to the results of basal or gonadotrophin releasing hormone (GnRH)-stimulated reproductive hormone assessments in female and male subjects treated with icatibant or placebo. Though the number of subjects participating was small, and the study was not powered for statistical significance, a suppressive effect of icatibant on GnRH-stimulated reproductive hormone concentrations was not generally observed in either sex. Overall, there were no clinically significant changes from baseline in basal and GnRH-stimulated concentrations of reproductive hormones (estradiol, progesterone, prolactin, dehydroepiandrosterone (DHEA), dehydroepiandrosterone-sulfate (DHEA-S), sex hormone binding globulin (SHBG), FSH, and LH in females and testosterone, DHEA, DHEA-S, SHBG, FSH, LH, and Inhibin-B in males) in response to treatment with icatibant. Additionally, there were no significant effects of icatibant on the concentration of luteal phase progesterone, an indicator of ovulation status and luteal function, or on menstrual cycle length in females, and there were no significant effects of icatibant on semen parameters in males.

Adrenal cortex function in male and female subjects, as assessed by serum cortisol concentrations, was unaffected by treatment with icatibant.

1.3 Rationale for Dose Selection

Icatibant has not been evaluated in clinical trial subjects below the age of 18 years. The proposed study will be the first in which icatibant is administered to pediatric subjects for treatment of acute HAE attacks. All subjects in the proposed study will receive a single, weight-adjusted dose of 0.4 mg/kg per attack as a SC injection up to a maximum dose of 30 mg.

This dose regimen was selected to target an exposure (C_{max} and area under the curve [AUC]) comparable to that observed in adults treated with icatibant. Only 1 dose of icatibant will be permitted for treatment of a single attack.

The 0.4 mg/kg dose was derived from pharmacokinetic/pharmacodynamic (PK/PD) modeling of data from a study (JE049-1001), which investigated the inhibitory potential of icatibant at various IV infusion doses and regimens after bradykinin challenge in healthy male subjects. The PK and PD data sets were used to model the PK/PD relationship of icatibant using a sigmoidal E_{max} model. A high degree of concordance of half maximal effective concentration (EC_{50}) values was obtained for each of the PD parameters studied (heart rate, blood pressure, and cutaneous blood flow) with the majority of values being between 8.54 and 9.77 ng/mL. Thus, a mean EC_{50} value of 9.5 ng/mL (7.3 nM) was used for subsequent PK/PD simulation. Based on the PK/PD modeling, IV icatibant doses of 0.4 mg/kg and 0.8 mg/kg were predicted to provide duration of therapeutic effect of as much as 9 or 13 hours, respectively, when infused over 0.5 to 1 hour. These results supported a minimum effective dose of 0.4 mg/kg to treat acute attacks of HAE. This corresponds to a dose of 30 mg of icatibant in a 75 kg subject.

A subsequent Phase II (JE049-2101) dose-ranging proof of concept efficacy study in HAE subjects was then conducted that examined the efficacy of doses ranging from 0.4 to 0.8 mg/kg IV (ie, 30 to 60 mg in a 75 kg person) and 30 to 45 mg SC. The results of this study indicated that SC administration of icatibant 30 mg produced a rapid onset of symptom relief and that 45 mg SC showed no improvement in efficacy over 30 mg SC.

As a result of clinical exploration of the efficacy, safety and exposure-response relationship of icatibant, a single SC administration of 30 mg icatibant (10 mg/mL formulation) was selected and consistently employed in the Phase III studies in adult HAE subjects. The totality of available efficacy information obtained from the Phase III clinical studies demonstrates that a single SC 30 mg dose of icatibant provides a sufficient magnitude and duration of effect to clinically manage the majority of acute attacks in adult HAE subjects across a wide range of demographics. Therefore, 0.4 mg/kg SC is considered an appropriate dose to study the tolerability, safety and PK of icatibant in the pediatric population.

2 STUDY OBJECTIVES

2.1 Objectives

The objectives of this study are:

- To investigate the PK, tolerability, and safety of a single SC dose of icatibant in children and adolescents with HAE during an acute HAE attack.
- To evaluate the efficacy of a single SC dose of icatibant in children and adolescents with HAE.
- To evaluate the effects on reproductive hormone levels after a single SC dose of icatibant in children and adolescents with HAE.

2.2 Other Objectives

Other objectives of this study are:

- To evaluate the continued safety of icatibant in pubertal/postpubertal children after repeated exposures.
- To evaluate the effects on reproductive hormone levels in pubertal/postpubertal children after repeated exposures.
- To evaluate the efficacy of icatibant in the treatment of acute HAE attacks in pubertal/postpubertal children after repeated exposures.

3 STUDY ENDPOINTS

3.1 Primary Endpoint(s)

The primary endpoints of this study are:

- The PK profile of icatibant after a single SC injection in pediatric subjects treated for acute attacks of HAE.
- The tolerability and safety of SC icatibant as assessed by injection site reactions, adverse events, vital signs, ECG recordings, physical examination, clinical laboratory parameters (serum chemistry [including liver function tests], hematology, urinalysis), reproductive hormone levels, and immunogenicity (presence of anti-icatibant antibodies).

3.2 Secondary Endpoint(s)

The secondary endpoints of this study are:

- For all subjects (2 to 17 years of age): investigator assessment and scoring of cutaneous, abdominal, and laryngeal symptoms of acute HAE attacks by an investigator-rated symptom score.
 - The time to onset of relief of symptoms, defined as the earliest time at which a 20% improvement is seen in the average post-treatment score with no worsening of any single component score.
 - The time to minimal symptoms, defined as the earliest time post treatment when all symptoms are either mild or absent based on the investigator-rated symptom score.
- For subjects ≥ 4 years of age only: subject self-assessment of HAE-related pain using the Faces Pain Scale-Revised (FPS-R).
 - The time to onset of relief of symptoms, defined as the earliest time at which a 20% improvement is seen in the post-treatment score.
- For subjects < 4 years of age only: investigator assessment of HAE-related pain (cutaneous, abdominal, and laryngeal) using the Faces, Legs, Activity, Cry, and Consolability (FLACC) scale.
 - The time to onset of relief of symptoms, defined as the earliest time at which a 20% improvement is seen in the total post-treatment score.
- The incidence of rescue medication use.
- The proportion of subjects with worsened intensity of clinical HAE symptoms between 2 and 4 hours after treatment with SC icatibant using investigator-rated symptom scores.

4 INVESTIGATIONAL PLAN

4.1 Overall Study Design and Plan

4.1.1 Study Design

This is an open-label, non-randomized, single-arm study to evaluate the PK, tolerability, and safety, including effects on reproductive hormones, of a single SC administration of icatibant in pediatric subjects with HAE during an initial acute attack.

The study will enroll children and adolescents from 2 to 17 years of age who present with cutaneous, abdominal, or laryngeal manifestations of an acute HAE attack after a qualifying screening period. Subject enrollment will be stratified into 2 groups based on pubertal status: (i) a prepubertal group (defined as Tanner stage I) and (ii) a pubertal/postpubertal group (defined as Tanner stages II to V). A subject's classification as prepubertal or pubertal/postpubertal will be determined at the time of the first icatibant-treated HAE attack. Subjects classified as pubertal/postpubertal at screening will not require further evaluation of pubertal status during the study, whereas subjects classified as prepubertal at screening will have their pubertal status reassessed at the time of their first icatibant-treated HAE attack visit.

Initially, enrollment and dosing of pubertal/postpubertal subjects will precede that of prepubertal subjects. After the first 4 subjects in the pubertal/postpubertal group have been treated, icatibant PK, safety, tolerability, and efficacy data will be reviewed by an independent Data and Safety Monitoring Board (DSMB). The DSMB review of the first 4 subjects shall be completed prior to continuing enrollment of additional pubertal/postpubertal subjects, icatibant treatment of second and third HAE attacks in pubertal/postpubertal subjects, and initiating enrollment of subjects in the prepubertal group.

Subjects will receive treatment with a single SC administration of icatibant on Day 1. Subjects will be monitored closely in the hospital/study center for at least 6 to 8 hours after treatment and will undergo PK, safety, and efficacy assessments. Subjects will also have serum reproductive hormone measurements. A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score must be zero, denoting the absence of symptoms). If HAE symptoms have not completely resolved at 6 hours (ie, the investigator-rated symptom score is >0), the subject shall remain in the hospital/study center for at least 8 hours after icatibant administration for further evaluation.

Safety follow-up to assess the subject's condition must be conducted at 24 and 48 hours after icatibant injection, and will occur either by a telephone call from study personnel or in person at the investigator's discretion. Subjects will return to the hospital/study center for scheduled assessments on Day 8 and for a follow-up visit on Day 90.

Pubertal/postpubertal subjects may be offered further open-label treatment with icatibant, contingent upon having been treated for an initial attack and presenting with a subsequent acute cutaneous, abdominal, or laryngeal attack of HAE at least 7 days after prior treatment. Open-label treatment will continue until at least 15 pubertal/postpubertal subjects have been treated

with icatibant for a total of 3 attacks each. Tolerability and safety assessments, including reproductive hormone measurements, will be performed at each subsequent icatibant-treated attack as for the initial treated attack. Subjects who reach their 18th birthday during the course of follow-up are allowed to remain in the study and receive subsequent treatments with icatibant according to the protocol.

The investigator will schedule a telephone contact approximately 6 months after Day 1 of each icatibant-treated attack to obtain specific updates concerning pubertal changes/milestones.

4.1.2 Study Assessments

The study will consist of the following periods (Table 4-r).

Table 4-1 Study Periods

Study Periods	
Screening	Day of informed consent through pretreatment on Day 1 of the initial attack
Initial icatibant-treated attack (All subjects)	
Treatment	Day 1
Post Treatment	Day 1 through Day 8 (\pm 1 day)
Follow-up	Day 9 through Day 90 (\pm 7 days)
Telephone Contact	Month 6 (\pm 7 days) from Day 1 of the attack
Two additional icatibant-treated attacks for a total of 3 icatibant-treated attacks (Pubertal/postpubertal subjects only)	
Treatment	Day 1
Post Treatment	Day 1 through Day 8 (\pm 1 day)
Follow-up	Day 9 through Day 90 (\pm 7 days)
Telephone Contact	Month 6 (\pm 7 days) from Day 1 of the attack

The study will include a screening period to determine subject eligibility. Eligibility will be evaluated after the subjects' parent(s)/legal guardian(s) and the subject (if applicable) provide informed consent/assent.

Study activities at screening will include confirmation of diagnosis of HAE type I or II by review of the subject's medical history and documentation of C1-INH deficiency (C1-INH protein level below the lower limit of normal and/or functional level <50% of normal) indicative of HAE Type I or II. Diagnosis may be supported by family history, characteristic attack manifestations, and recurrence of attacks. Other assessments performed at screening will include demography,

medical history and history of HAE, concomitant medication use, physical examination (including height and weight), pubertal status determination, vital signs, ECG, urine pregnancy test in female pubertal/postpubertal subjects, and blood sample collection for C1-INH testing.

In previously screened, eligible subjects who present with an attack of acute HAE, baseline clinical assessments for PK, safety, and efficacy will be performed on Day 1 at pretreatment. The initial severity and type of attack (ie, cutaneous, abdominal, or laryngeal) will be determined by the investigator. The investigator will complete baseline assessments at pretreatment of the symptoms of the acute HAE attack (including a separate assessment of HAE-related pain in subjects younger than 4 years of age), and adherence to inclusion/exclusion criteria will be reconfirmed. Subjects who are 4 years of age or older will perform a self-assessment of HAE-related pain. Other baseline assessments performed at pretreatment will include physical examination, pubertal status determination (only for those subjects classified as prepubertal at screening), height and weight, vital signs, collection of samples for clinical laboratory tests (serum chemistry [including liver function tests], hematology, urinalysis), urine pregnancy test for pubertal/postpubertal females, baseline PK and immunogenicity assessments, and baseline measurement of reproductive hormones (FSH, LH, estradiol, and progesterone in females and FSH, LH, and testosterone in males).

On Day 1, subjects will be administered a single dose of icatibant as an abdominal SC injection within 12 hours after the onset of the acute attack. The time of investigational product administration on Day 1 will be designated as Time 0. All post-treatment assessments will be calculated from the time of investigational product administration. PK, safety, and efficacy assessments will be performed on Day 1 after treatment at the time points indicated in the study (Y Y Y Y Y). These assessments will consist of physical examination, vital signs, ECG, clinical laboratory tests (serum chemistry [including liver function tests], hematology, urinalysis), injection site reactions, and measurement of reproductive hormones (FSH, LH, estradiol, and progesterone in females and FSH, LH, and testosterone in males) in all subjects. The investigator will complete assessments of symptoms of the acute attack of HAE for all subjects (including a separate assessment of HAE-related pain in subjects younger than 4 years of age). Subject who are 4 years of age or older will also complete a self-assessment of HAE-related pain.

A safety follow-up contact must occur at 24 (± 4) hours and 48 (± 4) hours after treatment, and will be conducted either by a telephone call from study personnel or in person at the discretion of the investigator.

Rescue medication use will be assessed through 48 (± 4) hours after treatment either in person or by telephone at the discretion of the investigator.

Subjects will return to the hospital/study center to undergo safety assessments, including physical examination, vital signs, and clinical laboratory tests (serum chemistry [including liver function tests], hematology, urinalysis), evaluation of injection site reactions, immunogenicity, and measurement of reproductive hormones on Day 8 (± 1 day) after treatment.

Subjects will be followed over a 90-day period after initial treatment. All subjects will provide blood samples for immunogenicity testing and measurement of reproductive hormone levels at

the Day 90 (± 7 days) visit and undergo safety assessments including physical examination, vital signs, and clinical laboratory tests (serum chemistry, hematology, and urinalysis). Additionally, females of childbearing potential will undergo urine pregnancy testing.

Subsequent open-label treatments with icatibant may be offered to pubertal/postpubertal subjects who have been treated for an initial attack and who present with a subsequent attack at least 7 days after prior treatment. In the event that a subsequent attack occurs at least 7 days after prior treatment, but within the window (± 1 day) allowed for performance of Day 8 assessments associated with a prior attack, the Day 8 assessments may also serve as the pretreatment (baseline) assessments for the subsequent attack. Open-label treatment will continue until a total number of at least 15 adolescents have been treated with icatibant for a total of 3 acute attacks (ie, after the first icatibant-treated attack, only pubertal/postpubertal subjects may receive further treatment with icatibant for up to 2 subsequent attacks of acute HAE). Except for PK determinations, all primary and secondary outcomes, including immunogenicity, are to be measured after each administration. Safety, reproductive hormones, and other assessments in association with subsequent attacks of acute HAE will be performed on Day 90 (± 7 days) after treatment (each treatment for a subsequent attack will require its own Day 90 follow up visit; however, if a subsequent attack occurs within 7 days of the Day 90 follow-up visit for the previous attack, the assessments on Day 8 and Day 90 may be combined).

The investigator will schedule a telephone contact approximately 6 months after Day 1 of each icatibant-treated attack to obtain updates concerning pubertal changes/milestones. If this prescheduled telephone contact date should occur within the 90-day follow-up period (ie, Day 1 through Day 90) of a subsequent attack, this prescheduled contact may be omitted.

All assessments are outlined in full in the study schedules of events Y Y, Initial Icatibant-treated Attack and Y|Subsequent Icatibant-treated Attacks.

4.2 Rationale for Study Design

This study has an open-label, single arm design.

The study is intended to determine the PK profile of SC icatibant when administered to children and adolescents being treated for an acute attack of HAE and to identify an optimal pediatric dosing regimen.

In addition, the study is intended to establish the tolerability and safety of icatibant in children and adolescents, particularly with respect to potential effects on reproductive development, and to demonstrate the effectiveness of icatibant in relieving the symptoms of acute HAE attacks. Therefore, this study will help determine whether icatibant can address an unmet medical need for a safe and effective treatment for acute attacks of HAE in pediatric patients.

4.3 Study Duration

Once eligibility is established at screening, the subject will be enrolled but will enter a period of inactive participation of variable duration until such time as the subject experiences an acute attack of HAE and is offered treatment. At that time, the subject will enter a 90-day period of

active participation which will consist of treatment with a single SC administration of icatibant on Day 1 through follow-up at Day 90.

After receiving treatment for an initial attack of acute HAE, at least 15 pubertal/postpubertal subjects who present with subsequent attacks of acute HAE will continue to receive treatment with icatibant for a total of 3 attacks each. Thus, the period of active participation in the study for prepubertal subjects will be approximately 90 days, while that for pubertal/postpubertal subjects will be a maximum of approximately 270 days (3 separate active periods of approximately 90 days), with each active period separated by periods of inactive participation of variable duration. The period of active participation may be shorter if pubertal/postpubertal subjects have recurrent HAE attacks in between the Day 8 and Day 90 visits for a prior icatibant-treated HAE attack. Telephone follow-up will occur approximately 6 months after each icatibant-treated attack.

Once the sixteenth prepubertal subject and the twentieth pubertal/postpubertal subject have completed the 6-month follow-up after treatment for an initial attack, and the fifteenth pubertal/postpubertal subject has completed the 6-month follow-up after his or her third and final treatment, the study will be closed.

The approximate overall duration of the study is expected to be 3 years.

5 STUDY POPULATION SELECTION

5.1 Study Population

The study will enroll a sufficient number of children and adolescents to ensure study completion of 36 evaluable subjects. The study population will consist of subjects from 2 through 17 years of age who present with an acute cutaneous, abdominal, or laryngeal HAE attack, at least 16 of whom were prepubertal at the time of their first icatibant treated HAE attack and 20 of whom were pubertal/postpubertal at the time of their first icatibant treated HAE attack.

5.2 Inclusion Criteria

Subjects must meet all of the following criteria to be considered eligible for enrollment.

1. Two through 17 years of age, inclusive (ie, from the second birthday until the day prior to the eighteenth birthday) at the time of the subject's first HAE attack treated with icatibant as part of this study.
2. Documented diagnosis of HAE type I or II. Diagnosis must be confirmed by C1-INH deficiency (C1-INH protein level below the lower limit of normal and/or functional level <50% of normal). Diagnosis may be on the basis of historic data or by diagnostic testing conducted at the time of screening. Inclusion will be permitted initially based on medical history only if a clear diagnosis has been made based on all of the following criteria:
 - Family history
 - Characteristic attack manifestations, recurrent attacks
 - Historical C1-INH deficiency as demonstrated by immunologic or functional test results
 - Exclusion of other forms of angioedema
 - Subsequent confirmation of the diagnosis to be made on the basis of C1-INH level or function (all subjects)
3. Informed consent (and subject assent as appropriate) signed by the subject's parent(s) or legal guardian(s).

5.3 Exclusion Criteria

Subjects will be excluded from the study if there is evidence of any of the following criteria at screening or at any time prior to the time of the first attack.

1. Diagnosis of angioedema other than HAE.
2. Participation in another clinical trial that involves use of any investigational product (drug or device) within 30 days prior to study enrollment or at any time during the study.
3. Any known factor/disease that might interfere with the treatment compliance, study conduct, or result interpretation.
4. Congenital or acquired cardiac anomalies that interfere significantly with cardiac function.
5. Treatment with angiotensin converting enzyme (ACE) inhibitors within 7 days prior to treatment.
6. Use of hormonal contraception within the 90 days prior to treatment.
7. Androgen use (eg, stanozolol, danazol, oxandrolone, methyltestosterone, testosterone) within the 90 days prior to treatment.

8. Pregnancy or breastfeeding.
9. A physical condition that interferes with pubertal status determination.

6 STUDY TREATMENT(S)

6.1 Description of Treatment(s)

6.1.1 Investigational Product

Icatibant is prepared as a sterile, isotonic, and acetate buffer solution containing sodium chloride, acetic acid, sodium hydroxide and water for SC injection, adjusted to pH 5.5 ± 0.3 . The solution does not contain any preservative.

The product is supplied as a 10 mg/mL (free base) solution in 3-mL glass syringes, with elastomeric stoppers, tip cap, plunger rod, and backstop. A fluid-dispensing connector will be used to secure a 1-mL or 3-mL syringe to the glass syringe. A single dose (see Section 6.2) will be withdrawn and administered by SC injection.

6.1.2 Comparator

Not applicable to this study.

6.2 Treatments Administered

All subjects will receive treatment with icatibant for an initial acute attack of HAE as a single, weight-adjusted dose of 0.4 mg/kg up to a maximum of 30 mg administered in the abdominal region as a SC injection.

The dosing regimen for treatment of subsequent attacks in pubertal/postpubertal subjects will be the same as that for treatment of the initial attack (ie, a single weight-adjusted dose of 0.4 mg/kg up to a maximum of 30 mg per attack administered as a SC injection). Thus, no more than 3 doses of icatibant will be administered to any subject during the study.

6.3 Selection and Timing of Dose for Each Subject

Each subject will be administered a single dose of icatibant as a SC injection within 12 hours after the onset of an acute HAE attack.

Subsequent treatment with icatibant for up to 2 additional attacks of acute HAE for a total of 3 attacks will be offered to pubertal/postpubertal subjects contingent upon having been treated for an initial attack and presenting with a subsequent acute attack at least 7 days after prior treatment (s Y Y-r-y).

6.4 Method of Assigning Subjects to Treatment Groups

Not applicable to this study. All subjects will be administered icatibant at a weight-adjusted dose of 0.4 mg/kg SC up to a maximum of 30 mg per treatment.

6.5 Blinding

Not applicable to this open-label study.

6.6 Concomitant Medication Usage

All prescription and over-the-counter medications that are being taken by subjects during the study are regarded as concomitant medications and must be documented on the case report form (CRF) following informed consent.

Use of the following concomitant medications is allowed during the study:

- All chronically administered medications, except for treatments of HAE, are allowed, but the dose and regimen must have been stable for at least 1 month before the first dose of icatibant in this study.
- Prophylactic therapies for HAE (eg, anti-fibrinolytics or C1-INH) other than attenuated androgens will be allowed, but therapies known to attenuate an acute HAE attack (eg, C1-INH concentrate, fresh-frozen plasma [FFP]) must not be used during the attack being treated with icatibant unless these are required as rescue medications (see Section 6.7). An exception is that fibrinolysis inhibitors may be given in a subject's usual, stable prophylactic regimen.

Use of the following concomitant medications is forbidden within 90 days prior to treatment, and for 90 days after receiving treatment with icatibant:

- ACE inhibitors.
- Androgens or attenuated androgens (eg, stanozolol, danazol, oxandrolone, methyltestosterone, testosterone).
- Hormonal contraceptives (acceptable contraception during the study for sexually active females will consist of abstinence or a double barrier method such as condom plus diaphragm, condom or diaphragm plus spermicide, condom or diaphragm plus intrauterine device).

6.7 Rescue Therapy

For the purposes of this protocol, rescue therapy is any medication used after the administration of icatibant which, in the opinion of the investigator, is immediately necessary to alleviate acute symptoms which are judged by the investigator as resultant from the current HAE attack.

Repeat administration of icatibant for treatment of a single attack is not allowed in this study.

The determination of the necessity for rescue therapy will be at the discretion of the investigator.

Rescue therapies will include agents to control the HAE attack, such as C1-INH inhibitor concentrates. C1-INH therapy has been used safely for the treatment of acute attacks in the pediatric setting.^h If C1-INH concentrates are unavailable, FFP may be used.^v ~~YA~~ kallikrein inhibitor, ecallantide, approved only in the United States, is indicated for use in patients 16 years of age and older.

Other acceptable rescue therapies for acute attacks include palliative medications that are intended to ameliorate the symptoms (eg, pain, nausea) of angioedema rather than to control the HAE attack itself. If pain medication is required, the investigator may administer intravenous or prescription-strength non-steroidal anti-inflammatory drugs (NSAIDs) for mild to moderate pain and administer morphine sulfate (or opiate equivalent) intravenously or intramuscularly at a dose of 0.05 mg/kg (or an equivalent dose if another opiate medication is used). Anti-emetics may also be prescribed as necessary to treat nausea. Acceptable rescue therapies may also include epinephrine, intravenous fluids, or other medicinal products at the discretion of the investigator.

Medications provided for rescue therapy will be denoted as rescue medications on the appropriate CRF. Antihistamines (diphenhydramine, loratadine, cetirizine, etc) and glucocorticoids are considered ineffective for the alleviation of an acute HAE attack. If administered during an acute attack that occurs during the study, they should be recorded as concomitant medications but will not be considered as rescue medications.

If rescue medication is provided, the investigator will document the drug name, amount, time, route of administration, frequency, and duration administered.

6.8 Restrictions

Subjects are not to receive treatment with any investigational product(s) other than icatibant or any investigational device(s) at any point during this study.

6.8.1 Fluid and Food Intake

No specific restrictions on fluid or food intake apply for this study.

6.8.2 Subject Activity Restrictions

No specific restrictions on subject activity apply for this study.

6.9 Treatment Compliance

During this study, the investigational product will be administered at the hospital/study center under controlled conditions; therefore, full subject compliance with treatment is anticipated.

6.10 Packaging and Labeling

The investigational product will be packaged as 3-mL solution in a pre-filled 3-mL syringe made of clear type I glass. The back stopper consists of bromobutyl coated with fluorocarbon polymer. Front closure is achieved by means of a luer-lock adaptor that allows secure attachment of the needle. Secondary packaging consists of 1 icatibant syringe, labeled in a tray with a 25-gauge needle placed inside a plain white carton, also labeled. A fluid-dispensing adaptor will be used to secure a 1-mL or 3-mL syringe to the glass syringe for withdrawal of icatibant.

See the Pharmacy Manual for additional details.

6.11 Storage and Accountability

The following information should be considered when storing and using the investigational product.

The investigational product will be shipped at 2° to 8°C. Icatibant 10 mg/mL formulated for SC administration should be stored at or below 25°C. The syringes must not be frozen.

The disposition of all investigational product delivered to a principal investigator must be recorded on a subject-by-subject basis by completing the clinical trial material accountability log. The date and time of administration of the investigational product must be documented on the appropriate CRF.

The principal investigator, clinical research coordinator, or designee (eg, pharmacist) must ensure that all documentation regarding investigational product receipt, storage, dispensing, loss/damaged and return or destruction of used/unused product is complete, accurate, and ready for review at each monitoring visit and/or audit.

The sites must ensure that the investigational product is available for the monitor to inventory and prepare for return shipment to the sponsor or designee, if required.

6.12 Investigational Product Retention at Study Site

The process for destruction of investigational product must be determined and documented during the study start-up phase.

If the investigational product is to be destroyed by the study sites, sites must follow their own process/policy that describes such activities. All drug destruction processes will be documented and the sites must retain copies of these documents within the site regulatory binder. The sites must ensure that the clinical trial material accountability and destruction log is complete, accurate, and ready for review and/or audit at each monitoring visit.

All manifests documenting shipments of investigational product must be retained as well copies of any investigational product return forms.

See the Pharmacy Manual for additional details.

7 STUDY PROCEDURES

Detailed descriptions of subject evaluations required for this protocol are described in this section. These evaluations will be performed during the indicated days and weeks of the study (see the study schedules of events Y Y, Initial Icatibant-treated Attack and [pendix 2IY](#) Subsequent Icatibant-treated Attacks).

All data collected are to be recorded on the appropriate CRF or electronic diary (e-diary) page.

Details for study procedures including sample collection are described in the Operations Manual for this study.

7.1 Informed Consent

Prior to conducting any study-related procedures, written informed consent must be obtained from the subject's parent(s) or legal guardian(s) and assent from the subject (if applicable).

The nature, scope, and possible consequences, including risks and benefits, of the study will be explained to the subject, the subject's parent(s), or the subject's legal guardian by the investigator or designee in accordance with the guidelines described in Section [rr-d](#). Documentation and filing of informed consent documents should be completed according to Section [rr-d](#).

7.2 Study Entrance Criteria

At screening, each subject will be reviewed for eligibility against the study entrance criteria. Subjects who do not meet the study entrance criteria will not be allowed to participate in the study. The reason(s) for the subject's ineligibility for the study will be documented.

7.3 Confirmation of Study Eligibility

Subject eligibility according to the study inclusion and exclusion criteria will be confirmed at the screening and pretreatment (baseline) visits on the basis of review of the study entrance criteria.

7.4 Demographics

Subject demographic information including gender, date of birth, and race will be collected prior to the subject receiving the first dose of investigational product.

7.5 Medical History

Medical history will be recorded in the CRF. Details of prior HAE attacks (eg, typical frequency, symptom duration, onset of relief, and type and frequency of medical interventions required) will be obtained at screening through pretreatment on Day 1. Other important medical events, menstrual cycle history Y Y Y (Y-h), and concomitant medication and illnesses will be recorded at other visits on the appropriate CRF pages. Any existing medical condition present prior to the time of the first dose will be reported as medical history.

7.6 Menstrual Cycle History

A menstrual cycle history will be determined historically for female subjects and will be recorded in the CRF. The timing of the blood sampling with respect to the menstrual cycle must be known to inform the interpretation of any potential changes in reproductive hormones in adolescent females, because of the normal cyclical rise and fall of reproductive hormones of the menstrual cycle.

Instructions for investigators:

To assist in this determination, investigators should obtain the following information and document in the CRF.

- Age of menarche.
- Normal duration of menstrual flow.
- Normal interval in between menstrual periods.
- Date of last onset of bleeding.
- Prospectively ask female subjects to write down subsequent dates of onset of bleeding and cessation of bleeding between Day 1 and Day 90.
- Date of ovulation (sometimes called ovulation pain, mid-cycle pain or mittelschmerz) may also be documented if subjects can identify this feeling.

7.7 Height and Weight

Height and weight will be recorded for all subjects.

7.8 Pubertal Status Determination

The investigator will perform an examination for all subjects to determine whether they are prepubertal or pubertal/postpubertal. A description of the sexual maturation scale described by Marshall and ^{g1W} is provided Y ^Y.

7.9 Investigational Product Administration

All subjects will receive treatment with icatibant for an initial acute attack of HAE as a single, weight-adjusted dose of 0.4 mg/kg administered as an abdominal SC injection up to a maximum dose of 30 mg. Treatment with icatibant will be administered within 12 hours of onset of an acute HAE attack. Pubertal/postpubertal subjects that present with a subsequent attack at least 7 days after prior treatment (s Y ^{Y-r -y}) may receive further treatment with icatibant for a total of 3 attacks.

7.10 Pharmacokinetic Assessments

7.10.1 Pharmacokinetic Variables

PK variables will be determined by full sampling and noncompartmental methods where possible, and elsewhere by sparse sampling (at least 4 to 7 time points) and a population PK approach using nonlinear mixed effects modeling software. The methods to be used for estimation of PK parameter values are described in Section [rf-x-r](#).

PK parameter estimates will include, where appropriate: actual icatibant and metabolite concentrations at each sampling time, time to peak concentration (T_{max}), actual peak (C_{max}) and minimum (C_{min}) concentrations, clearance (CL/F), actual area under the plasma concentration-time curve (AUC_{0-last} and AUC_{0-inf}), mean residence time (MRT), volume of distribution at steady state (V_{ss}/F) and elimination half-life ($t_{1/2}$).

7.10.2 Pharmacokinetic Sampling

Sampling for PK assessments will be collected according to the schedule of events provided in [Y](#), Initial Icatibant-treated Attack.

The time of investigational product administration on Day 1 will be designated as Time 0. All post-treatment assessments will be calculated from the time of investigational product administration. Detailed sample collection, processing, and shipping instructions will be provided in the study Operations Manual.

Blood samples for determination of plasma concentrations of icatibant in pubertal/postpubertal subjects will be collected on Day 1 at pretreatment, and at 15 (± 5) minutes, 30 (± 5) minutes, 45 (± 5) minutes, 1 hour (± 10) minutes, 2 hours (± 10) minutes, 4 (± 0.5) hours, and 6 (± 0.5) after treatment.

Blood samples for determination of plasma concentrations of icatibant in prepubertal subjects will be collected on Day 1 at pretreatment, and at 15 (± 5) minutes, 30 (± 5) minutes, 2 hours (± 10) minutes, 4 (± 0.5) hours, and 6 (± 0.5) hours after treatment.

7.10.3 Bioanalytical Method

Plasma samples will be assayed for concentrations of icatibant and its metabolites (M1 and M2) using a validated method (see Section [v-yr](#)).

7.11 Efficacy Assessments

7.11.1 Investigator Symptom Score

The investigator will use a symptom score to assess the severities of symptoms of acute cutaneous, abdominal, and laryngeal attacks of HAE using the following 5-point scale. Symptom scores will be recorded on Day 1 at pretreatment and at predetermined time points after treatment. Results will be recorded in the CRF.

Investigator-rated Symptom Score

- 0 = none; absence of symptoms
- 1 = mild (no to mild interference with daily activities)
- 2 = moderate (moderate interference with daily activities)
- 3 = severe (severe interference with daily activities)
- 4 = very severe (very severe interference with daily activities)

For attacks classified as cutaneous and/or abdominal, investigator-rated symptom scores will be collected for 8 symptoms: abdominal tenderness, nausea, vomiting, diarrhea, skin pain, erythema, skin irritation, and skin swelling.

For attacks classified as laryngeal, investigator-assessed symptom scores will be collected for 13 symptoms: abdominal tenderness, nausea, vomiting, diarrhea, skin pain, erythema, skin irritation, skin swelling, dysphagia, voice change, breathing difficulties, stridor, and asphyxia.

7.11.2 Subject Self-assessment of Pain

Subjects who are at least 4 years of age will self-assess HAE-related pain using the Faces Pain Scale-Revised (FPS-R). A copy of the FPS- Y Y Y Y Y.

FPS-R self-assessment data will be recorded in an electronic diary (e-diary). Subjects will record self-assessments on Day 1 at pretreatment and at predetermined time points after treatment while at the hospital/study center, and after their discharge to home. Subjects will return the e diary to the hospital/study center at the scheduled visit on Day 8.

Subjects will receive detailed instruction on when and how to use the e-diary from the investigator and/or clinical site personnel.

7.11.3 Investigator Assessment of Pain

Subjects who are below 4 years of age will undergo investigator assessment of HAE-related pain (cutaneous, abdominal, and laryngeal) using the Faces, Legs, Activity, Cry, and Consolability (FLACC) compartmental pain scale. A cop Y Y Y Y Y Y Y Y Y.

7.11.4 Initial Symptom Relief

The investigator will be asked to record the date and time when overall subject improvement was first noted and mark the date and time accordingly in the CRF.

7.12 Reproductive Hormone Assessments

Reproductive hormone levels will be measured in all subjects. Blood samples will be collected to assess FSH, LH, estradiol, and progesterone in females, and FSH, LH, and testosterone in males.

7.13 Safety Assessments

7.13.1 Physical Examination

Physical examinations will include a review of the subject's general appearance as well as evaluation of the body systems. Any clinically significant abnormal change in findings will be recorded as an adverse event (AE) on the appropriate CRF. The physical examination will include the following:

- General appearance
- Eye, ears, nose, throat
- Lymph nodes
- Cardiovascular
- Skin
- Abdomen
- Neurological
- Spine and extremities
- Lungs

7.13.2 Vital Signs

Vital signs are to be recorded for all subjects and will include pulse, blood pressure, respiration rate, and temperature.

7.13.3 Electrocardiography

A standard 12-lead ECG will be performed after 10 minutes at rest when the patient is seated or supine. ECG results will be read locally at the clinical site. Abnormalities will be recorded.

7.13.4 Clinical Laboratory Tests

Blood and urine samples will be collected as described in this section for clinical laboratory testing. The clinical laboratory tests to be performed are listed in [Table 7-r](#).

Table 7-1 List of Clinical Laboratory Tests

Hematology:	Serum Chemistry:
<ul style="list-style-type: none">- Hematocrit- Hemoglobin- Mean corpuscular hemoglobin- Mean corpuscular hemoglobin concentration- Mean corpuscular volume- Platelet count- Red blood cell count- White blood cell count with differential	<ul style="list-style-type: none">- Albumin- Alkaline phosphatase- Alanine aminotransferase- Aspartate aminotransferase- Calcium- Carbon dioxide- Chloride- Creatinine- Creatine kinase- Gamma-glutamyl transferase- Glucose- Lactate dehydrogenase- Phosphorus- Potassium- Sodium- Total bilirubin
Urinalysis: <ul style="list-style-type: none">- Appearance- Bilirubin- Color- Glucose- Ketones- Nitrite- Occult blood- pH- Protein- Specific gravity	

7.13.5 Local Tolerability

Injection site reactions (erythema, swelling, burning sensation, itching/pruritis, warm sensation, cutaneous pain, or other) will be evaluated by the investigator or other medically qualified personnel when the subject is at the hospital/study center, and the diameter of any erythema or swelling will be measured.

After discharge, the subject (or the subject's parent/legal guardian on behalf of the subject as appropriate) will be interviewed about injection site reactions, either in person or by telephone contact.

7.13.6 Immunogenicity

The immunogenicity of icatibant will be assessed. Serum samples for immunogenicity testing will be collected for determination of anti-icatibant antibodies. Serum samples will be analyzed for anti-icatibant antibodies at Shire HGT or at a designated laboratory. Details concerning sample collection and preparation will be provided in the study Operations Manual.

Samples will be stored frozen at -65°C or below if not shipped on the day of collection. Details for shipping will be provided in the study Operations Manual.

7.13.7 Pregnancy Testing

Female subjects of childbearing potential (ie, those who have experienced menarche) will undergo pregnancy testing at time points specified in the study schedule of events Y Y Y. All pregnancy testing will be conducted using a urine human chorionic gonadotropin (hCG) test kit. The test will be performed and interpreted by the study personnel at the hospital/study center at the time of the visit.

7.14 Sample Collection, Storage, and Shipping

Blood samples will be collected via venipuncture. Use of an indwelling catheter is encouraged for collection of serial blood samples for PK assessments when feasible. Use of a topical local anesthetic (such as EMLA or LMX) is acceptable to make the procedure more tolerable for children, provided that the timing of this application does not interfere with blood sample collection. Subjects will be in a seated or supine position during blood collection.

All samples will be stored and secured in a way that assures that unauthorized access is prohibited and the samples are not lost, allowed to deteriorate, or are accidentally or illegally destroyed. Detailed sample collection, processing, and shipping instructions will be provided in the study Operations Manual.

7.15 Recording of Concomitant Medications

All medications administered to the study subjects from the time of informed consent through the follow-up visit 90 (± 7) days after investigational product administration are regarded as concomitant and will be documented in the CRF. Concomitant medications are defined in Y-h.

7.16 Recording of Adverse Events

Adverse events will be collected over an observation period from the time of treatment until the follow-up visit 90 (± 7) days after investigational product administration (or until the event has resolved/stabilized or an outcome is reached, whichever comes first). Adverse event monitoring Y Y Y Y Y Y Y Y Y Y Y Y Y-r v-d-r.

7.17 Adverse Events Assessments

7.17.1 Definitions of Adverse Events and Serious Adverse Events

7.17.1.1 Adverse Event

An adverse event is any noxious, pathologic, or unintended change in anatomical, physiologic, or metabolic function as indicated by physical signs, symptoms, or laboratory changes occurring in a clinical study, whether or not considered investigational product related. This includes an exacerbation of a pre-existing condition. However, any exacerbation or worsening of symptoms of an acute HAE attack treated with icatibant is considered a result of the underlying disease and will not be considered an adverse event (unless meeting the criteria for a serious adverse event, s Y Y-r v-r-y).

Adverse events include:

- Worsening (change in nature, severity, or frequency) of conditions present at the onset of the study (with the exception of HAE).
- Intercurrent illnesses.
- Drug interactions.
- Events related to or possibly related to concomitant medications.
- Clinically significant abnormal laboratory values (this includes significant shifts from baseline within the range of normal that the investigator considers to be clinically important).
- Clinically significant abnormalities in physical examination, vital signs, and weight.

The investigator must record all adverse events in the CRF, regardless of the severity or relationship to investigational product. The investigator should treat subjects with adverse events appropriately and observe them at suitable intervals until the events stabilize or resolve. Adverse events may be discovered through observation or examination of the subject, questioning of the subject, complaint by the subject, or by abnormal clinical laboratory values.

In addition, adverse events may also include laboratory values that become clinically significantly out of range. In the event of an out-of-range value, the laboratory test should be repeated until it returns to normal or stabilizes, or can be medically explained, and the subject's safety is not at risk.

Additional illnesses present at the time when informed consent is given until the time of treatment are regarded as concomitant illnesses and will be documented on the medical history page of the CRF. Illnesses first occurring or detected on or after treatment, and worsening of a concomitant illness during the study, are to be regarded as adverse events and must be documented as such in the CRF.

The treated HAE attack is defined as any symptoms occurring in treated subjects within 48 hours of the onset of symptoms. A clinically relevant worsening of the signs and symptoms of a treated attack is considered to be related to the underlying disease of HAE, and will be collected in the appropriate CRF separately from general reports of adverse events unless meeting the criteria of a serious adverse event. Symptoms reoccurring more than 48 hours after an initial attack will be considered a new attack, and will also not be reported as adverse events. Attacks not treated with icatibant will be documented in the appropriate CRF at the Day 90 visit; they are considered to be pre-existing disease and will not be documented as adverse events.

Local tolerability will include symptoms at the site of icatibant administration (injection site) and will be assessed separately from general reports of adverse events. Injection site reactions will be documented in the "local tolerability" page of the CRF. Injection site reactions that have been reported previously with icatibant included erythema, swelling, burning sensation, itching, warmth and pain and were generally, mild to moderate, transient, and resolved without sequelae. Injection site reactions that do not meet the criteria of a serious adverse event will not need to be additionally reported as adverse events.

7.17.1.2 Serious Adverse Event

A serious adverse event (SAE) is any adverse event occurring at any dose that results in any of the following outcomes:

- Death.
- Is life-threatening.
- Requires hospitalization.
- Requires prolongation of existing hospitalization.
- A persistent or significant disability or incapacity.
- A congenital anomaly or birth defect.

Important medical events that may not result in death, be life-threatening, or require hospitalization may be considered a serious adverse event when, based upon appropriate medical judgment, they may jeopardize the subject and may require medical or surgical intervention to prevent one of the outcomes listed in this definition. A life-threatening adverse event is defined as an adverse event that placed the subject, in the view of the initial reporter, at immediate risk of death from the adverse event as it occurred (ie, it does not include an adverse event that, had it occurred in a more severe form, might have caused death).

7.17.2 Classification of Adverse Events and Serious Adverse Events

The severity of adverse events will be assessed by the investigator as mild, moderate, or severe. Y Y Y Y Y [Table 7-y](#). The severity of adverse events and serious adverse events should be recorded on the appropriate CRF page as Grade 1, 2, or 3, corresponding, respectively, to a severity of mild, moderate, or severe.

Table 7-2 Adverse Event Severity

Grade	Severity	Definition
Grade 1	Mild	No limitation of usual activities.
Grade 2	Moderate	Some limitation of usual activities.
Grade 3	Severe	Inability to carry out usual activities.

7.17.2.1 Clarification between Serious and Severe

The term “severe” is often used to describe the intensity (severity) of a specific event (as in mild, moderate, or severe myocardial infarction); the event itself, however, may be of relatively minor medical significance (eg, severe headache). This is not the same as “serious,” which is based on the outcome or action criteria usually associated with events that pose a threat to life or functioning. Seriousness (not severity) and causality serve as a guide for defining regulatory reporting obligations.

7.17.3 Relatedness of Adverse Events and Serious Adverse Events

Relationship of an adverse event or serious adverse event to investigational product is to be determined by the investigator based on the following definitions (see [Table 7-p](#)).

Table 7-3 Adverse Event Relatedness

Relationship to Product(s)	Definition
Not Related	Unrelated to investigational product
Possibly Related	A clinical event or laboratory abnormality with a reasonable time sequence to administration of investigational product, but which could also be explained by concurrent disease or other drugs or chemicals.
Probably Related	A clinical event or laboratory abnormality with a reasonable time sequence to administration of investigational product, unlikely to be attributable to concurrent disease or other drugs and chemicals and which follows a clinically reasonable response on de-challenge. The association of the clinical event or laboratory abnormality must also have some biologic plausibility, at least on theoretical grounds.
Definitely related	The event follows a reasonable temporal sequence from administration of the investigational product, follows a known or suspected response pattern to the investigational product, is confirmed by improvement upon stopping the investigational product (de-challenge), and reappears upon repeated exposure (re-challenge). Note that this is not to be construed as requiring re-exposure of the subject to investigational product; however, the determination of definitely related can only be used when recurrence of event is observed.

7.17.4 Procedures for Recording and Reporting Adverse Events

7.17.4.1 Adverse Event Monitoring and Period of Observation

Adverse events will be monitored continuously. For the purposes of this study, the safety observation period will extend from the time of treatment of the subject's acute HAE attack until the subject's final evaluation after treatment. For subjects who complete the study, the final evaluation of adverse events will occur at the follow-up visit performed 90 (± 7) days after treatment with investigational product.

If the investigator considers it necessary to report an adverse event in a subject after the end of the safety observation period, he or she should contact the sponsor to determine how the adverse event should be documented and reported.

7.17.4.2 Reporting Serious Adverse Events

Any serious adverse event, regardless of relationship to investigational product, which occurs in a subject after informed consent, should be recorded by the clinical site on a serious adverse event form. The serious adverse event must be completely described on the subject's CRF, including the judgment of the investigator as to the relationship of the serious adverse event to the investigational product.

The investigator will promptly supply all information identified and requested by the sponsor (or contract research organization [CRO]) regarding the serious adverse event. The investigator must report the serious adverse event to the Shire Pharmacovigilance and Risk Management Department AND to the Shire HGT Medical Monitor on a serious adverse event form. This form must be completed and faxed or emailed within 24 hours of the investigator's learning of the event to:

Shire Pharmacovigilance and Risk Management Department:

FAX: PPD [REDACTED] (Worldwide) OR PPD [REDACTED] (North America)

Email: PPD [REDACTED]

AND

Shire HGT Medical Monitor: PPD [REDACTED] MD, PhD

PPD [REDACTED]

FAX: PPD [REDACTED] (USA)

Any follow-up information must also be completed on a serious adverse event form and faxed or emailed to the same numbers listed above.

In the event of a severe and unexpected, fatal, or life-threatening serious adverse event, the clinical site must contact the Shire HGT Medical Monitor by telephone; this is in addition to completing and transmitting the serious adverse event form as stated above. The following provides contact information for the Shire HGT Medical Monitor.

If a serious adverse event is assessed as severe and unexpected, or life-threatening, contact:

If an SAE is assessed as severe and unexpected, or life-threatening, contact:
<p style="text-align: center;">PPD [REDACTED] MD, PhD PPD [REDACTED] Shire Human Genetic Therapies, Inc. 300 Shire Way Lexington, MA 02421 USA Telephone: PPD [REDACTED] Mobile: PPD [REDACTED] Fax: PPD [REDACTED] (USA) PPD [REDACTED]</p>

The investigator must promptly report all required information to the Institutional Review Board (IRB)/Independent Ethics Committee (IEC). It is the responsibility of the sponsor to ensure that each investigator receives a copy of any Council for International Organizations of Medical Sciences (CIOMS I)/MedWatch report that has been submitted to the appropriate regulatory agencies notifying them of an unexpected related serious adverse event.

The investigator or sponsor must ensure that the IRB/IEC receives a copy of the report and that a copy is also filed within their study files.

7.18 Pregnancy

Pregnancy and lactation are exclusion criteria for this study. The sponsor must be notified in the event of a pregnancy occurring during the course of the study and through 180 days after the subject's last dose of investigational product. Pregnancy is not to be reported as an adverse event; the pregnancy reporting form should be used to report the pregnancy. The pregnancy will be followed up through delivery or final outcome.

7.19 Abuse, Overdose, and Medication Error

- **Abuse** – Persistent or sporadic intentional intake of investigational medicinal product at a dose higher than prescribed per protocol (but below the dose defined for overdose) or when used for non-medical purpose (eg, altering one's state of consciousness).
- **Misuse** – Intentional or unintentional use of investigational medicinal product other than as directed or indicated at any dose, which is at or below the dose defined for overdose (Note: this includes a situation where the test article is not used as directed at the dose prescribed by the protocol).

- **Overdose** – No clinical information on overdose is available. A dose of 3.2 mg/kg (approximately 8 times the therapeutic dose) caused transient erythema, itching or hypotension in healthy subjects. No therapeutic intervention was necessary.
- **Medication Error** – A mistake made in prescribing, dispensing, administration and/or use of the investigational medicinal product.

All investigational medicinal product provided to pediatric subjects should be supervised by the parent(s)/legal guardian(s)/caregiver(s).

7.20 Removal of Subjects from the Trial or Investigational Product

A subject's participation in the study may be discontinued at any time at the discretion of the investigator. The following may be justifiable reasons for the investigator to remove a subject from the study:

- Non-compliance, including failure to appear at one or more study visits.
- The subject was erroneously included in the study.
- The subject develops an exclusion criterion.
- The subject suffers an intolerable adverse event.
- The study is terminated by the sponsor.
- The study is closed prior to the subject's first eligible attack.

The subject, the subject's parent(s), or the subject's legal guardian(s) acting on behalf of the subject is free to withdraw consent and discontinue participation in the study at any time without prejudice to further treatment.

If a subject or the subject's parent(s) or the subject's legal guardian(s) acting on behalf of the subject, discontinues participation in the study, or the subject is discontinued by the investigator, the subject completion/discontinuation CRF describing the reason for discontinuation must be completed. Any adverse events experienced up to the point of discontinuation must be documented in the CRF. If adverse events are present when the subject withdraws from the study, the subject will be re-evaluated within 30 days of withdrawal. All ongoing serious adverse events at the time of withdrawal will be followed until resolution.

7.20.1 Safety-Related Study Stopping Rules

The Data and Safety Monitoring Board (DSMB) (see Appendix Y for a description of the DSMB and its role) may elect to suspend the study until the DSMB can review any death that is drug or disease-related or unexplained, or if there is an unexpected drug-related severe AE.

Following the review of safety data, the study will be either:

- Resumed unchanged.
- Resumed with modifications to the protocol.
- Terminated.

Subject safety will be monitored on a continuous basis during this study until the last subject completes his or her last scheduled study visit/assessment.

Additional information on safety monitoring can be found in Section [rr-g](#).

7.21 Appropriateness of Measurements

The safety assessments used in this study are standard and will provide a detailed measure of the safety of icatibant in the pediatric population.

The measures of serum reproductive hormone concentration are accepted measures for assessing the function of reproductive organs.

Plasma samples will be assayed for concentrations of icatibant and its 2 major metabolites (M1 and M2) using a validated high-performance liquid chromatography/tandem mass spectrometry (LC-MS/MS) method with a lower limit of quantification of 1 ng/mL and a range from 1 to 1000 ng/mL (Analytical Report SHR10-002). PK variables will be determined by full sampling and noncompartmental methods where possible, and elsewhere by sparse sampling (at least 4 to 7 time points) and a population PK approach using non-linear mixed effects modeling software.

The symptom score used in efficacy assessments in this study is an investigator-rated measure of symptom severity based on a standard 5-point scoring system (0-absence of symptoms, 1-mild, 2-moderate, 3-severe, 4-very severe) capturing symptoms of acute attacks of HAE that have been identified and validated to assess efficacy in adults. For attacks classified as abdominal or cutaneous, investigator-rated symptom scores are collected for 8 symptoms: abdominal tenderness, nausea, vomiting, diarrhea, skin pain, erythema, skin irritation, and skin swelling.

For attacks classified as laryngeal, investigator-assessed symptom scores are collected for 13 symptoms: abdominal tenderness, nausea, vomiting, diarrhea, skin pain, erythema, skin irritation, skin swelling, dysphagia, voice change, breathing difficulties, stridor, and asphyxia.

In all pediatric subjects in the present study, irrespective of age, the investigator-rated symptom score will provide an appropriate means to measure the severity of primary symptoms (eg, cutaneous and/or abdominal pain, cutaneous swelling, or laryngeal symptoms) of acute attacks of HAE at pretreatment and the change in symptom severity, if any, after treatment with icatibant.

Though subject-reported outcomes such as the symptom score and visual analog scale (VAS) have been employed successfully as efficacy measures in clinical studies of icatibant in adults, the use of these subject-reported outcomes in children poses special challenges. The Faces Pain Scale is a validated, self-reported measure used to assess the intensity of children's pain in a wide variety of clinical contexts.^{rf} The Faces Pain Scale-Revised (FPS-R) was adapted from the original FPS in order to make it possible to score pain on a widely accepted 0-to-r f Y ^{-rr} The scales are suitable for use in assessment of the intensity of children's acute pain from age 4 onward, are simple to administer, and require no specialized equipment other than the standardized images of faces. Use of the FPS-R is planned for this study, and will provide an appropriate means to measure pain associated with acute attacks of HAE in pediatric subjects who are at least 4 years of age.

Young children (ie, those below the age of 4 years) frequently lack the verbal and cognitive skills necessary to report physical discomfort and pain intensity. Behavioral cues are the primary indicators of pain in children who are unable to report pain or follow instructions in the use of assessment tools. The FLACC instrument comprises 5 categories of behavior (face, legs, activity, cry, consolability) to assess pain in preverbal children or children with limited verbal capability.^{rlyYp} Each category is scored on a 0-to-2 scale which results in a total score from 0 to 10.

Collectively, the measures employed in this study are expected to allow for assessment of the PK profile, tolerability, and safety, and efficacy of icatibant in the pediatric population.

8 STUDY ACTIVITIES

8.1 Screening (Day of Informed Consent to Pretreatment on Day 1 of the Initial Attack)

- Informed Consent/Assent
- Inclusion/Exclusion Criteria
- Medical History
- Confirmation of documented HAE diagnosis
- Measurement of C1-INH
- Pubertal status determination
- Physical examination
- Vital signs
- ECG
- Height and weight
- Urine pregnancy test (in females of childbearing potential)
- Recording of concomitant medications

8.2 Pretreatment (Baseline) Assessments (Day 1, Initial and Subsequent Attacks)

The following assessments will be performed at both initial and subsequent icatibant-treated attacks unless otherwise indicated. All evaluations and sample collections must be performed prior to treatment.

- Medical history (at initial attack only)
- Confirm inclusion/exclusion criteria
- Pubertal status determination (only if the subject was classified as prepubertal at the time of the screening visit)
- Menstrual cycle history (in pubertal/postpubertal females only)
- Physical examination
- Vital signs
- ECG (at subsequent attacks only)
- Height and weight
- Subject self-assessment of HAE-related pain (in subjects 4 years of age and older) using e-diary FPS-R
- Investigator assessment of HAE symptoms
- Investigator assessment of HAE-related pain (in subjects younger than 4 years of age only) using FLACC
- Clinical laboratory tests (serum chemistry, hematology and urinalysis)
- Urine pregnancy test (in females of childbearing potential)
- Reproductive hormone assessments
- Pharmacokinetic assessment (at pretreatment for initial attack only)
- Immunogenicity assessment

- Recording of concomitant medications
- Assessment of adverse events (at pretreatment for subsequent attacks only)

8.3 Initial Attack

8.3.1 Treatment Period (Day 1 to Day 8 [± 1 Day])

- Investigational product administration (Day 1, Time 0)
- Physical examination (Day 1, 6 (±0.5) hours) [or 8 (±0.5) hours] if the subject is not discharged^{***}] post dose and Day 8 (±1 day))
- Vital signs (Day 1, 1 hour (±10 minutes), 6 (±0.5) hours) [or 8 (±0.5) hours if the subject is not discharged^{***}] post dose and Day 8 (±1 day))
- ECG (Day 1, 6 (±0.5) hours [or 8 (±0.5) hours if the subject is not discharged^{***}] post dose)
- Subject self-assessment of HAE-related pain (in subjects 4 years of age and older) using e-diary FPS-R (Day 1, 1 hour (± 10 minutes), 2 hours (± 10 minutes), 4 (±0.5) hours, 6 (±0.5) hours and 8* (±0.5) hours post dose, Day 2 (24 (± 4) hours), Day 3 (48 (±4) hours))
- Investigator assessment of HAE symptoms (Day 1, 1 hour (±10 minutes), 2 hours (± 10 minutes), 4 (±0.5) hours, 6 (±0.5) hours [and 8 (±0.5) hours if the subject is not discharged^{**}] post dose)
- Investigator assessment of HAE-related pain (in subjects younger than 4 of age only) using FLACC (Day 1, 1 hour (±10 minutes), 2 hours (±10 minutes), 4 (±0.5) hours, 6 (±0.5) hours [and 8 (±0.5) hours if the subject is not discharged^{**}] post dose)
- Clinical laboratory tests (Day 1, 6 (±0.5) hours post dose and Day 8 (±1 day))
- Reproductive hormone assessments (Day 1, 6 (±0.5) hours post dose and Day 8 (±1 day))
- Injection site reaction assessment (Day 1, 1 hour (±10 minutes), 6 (±0.5) hours [and 8 (±0.5) hours if the subject is not discharged^{**}] post dose, Day 2 (24 (±4) hours), Day 3 (48 (±4) hours), and Day 8 (±1 day))
- Sampling for PK assessments in pubertal/post pubertal subjects (Day 1, 15 minutes (±5 min), 30 minutes (±5 min), 45 minutes (±5 min), 1 hour (± 10 minutes), 2 hours (±10 minutes), 4 (±0.5) hours, 6 (±0.5) hours post dose at initial attack only)
- Sampling for PK assessments in prepubertal subjects (Day 1, 15 (± 5) minutes, 30 (± 5) minutes, 2 hours (±10 minutes), 4 (±0.5) hours, 6 (±0.5) hours post dose at initial attack only)
- Safety follow-up contact (Day 2 (24 (±4) hours), Day 3 (48 (±4) hours)) either by telephone or in person at the investigator's discretion
- Immunogenicity assessment (Day 8 (±1 day))
- Menstrual cycle history (Day 8 (±1 day) (in pubertal/postpubertal females))
- Recording of concomitant medications
- Assessment of adverse events

*A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score = zero, denoting the absence of symptoms).

If this is the case, the assessments scheduled for 8 hours post treatment will be omitted with the exception of subject self-assessment of HAE-related pain using the e-diary FPS-R.

**If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score \neq zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at both 6 AND 8 hours post treatment.

***If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score \neq zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at either 6 OR 8 hours post treatment.

8.3.2 Follow-up Visit (Day 90 \pm 7 days)

In the event that a subject has a subsequent HAE attack within the 90 day follow-up period for the first treatment, the date of the Day 90 follow-up visit for the first treatment remains the same. Each subsequent treatment will have a corresponding Day 90 follow-up visit.

- Physical examination
- Vital signs
- Height and weight
- Clinical laboratory tests (serum chemistry, hematology, and urinalysis)
- Urine pregnancy test (in females of childbearing potential)
- Reproductive hormone assessments
- Immunogenicity assessment
- Menstrual cycle history (in pubertal/postpubertal females)
- Recording of concomitant medications
- Assessment of adverse events
- Documentation of HAE attack(s) not treated with icatibant

8.3.3 Telephone Contact (Month 6 \pm 7 days)

The scheduled telephone contact will document pubertal changes/milestones, if any.

- Pubarche
- Menarche (females only)
- Changes in menstrual cycle (females only)
- Pregnancy (females and male partner)

8.4 Subsequent Attacks (Pubertal/postpubertal Subjects Only)

Pubertal/postpubertal subjects may receive treatment for up to 2 subsequent HAE attacks, contingent upon having been treated for an initial attack and presenting with a subsequent acute attack of at least 7 days after prior treatment (see [Y-1-r-y](#)).

Each treatment for a subsequent attack will require a Day 90 follow up visit. If a subsequent attack occurs within 7 days of the Day 90 follow-up visit for the previous attack, the assessments on Day 8 and Day 90 will be combined.

8.4.1 Treatment Period (Day 1 to Day 8 [± 1 Day])

- Investigational product administration (Day 1, Time 0)
- Physical examination (Day 1, 6 (±0.5) hours [or 8 (±0.5) hours if the subject is not discharged^{***}] post dose and Day 8 (±1 day))
- Vital signs (Day 1, 1 hour (±10 minutes), 6 (±0.5) hours [or 8 (±0.5) hours if the subject is not discharged^{***}] post dose and Day 8 (±1 day))
- ECG (Day 1, 6 (±0.5) hours [or 8 (±0.5) hours if the subject is not discharged^{***}] post dose)
- Subject self-assessment of HAE symptoms in subjects 4 years of age and older using e-diary FPS-R (Day 1, 1 hour (±10 minutes), 2 hours (±10 minutes), 4 (±0.5) hours, 6 (±0.5) hours and 8* (±0.5) hours post dose, Day 2 (24 (±4) hours), Day 3 (48 (±4) hours))
- Investigator assessment of HAE symptoms (Day 1, 1 hour (±10 minutes), 2 hours (±10 minutes), 4 (±0.5) hours, 6 (±0.5) hours [and 8 (±0.5) hours if the subject is not discharged^{**}] post dose)
- Investigator assessment of HAE-related pain (in subjects younger than 4 years of age only) using FLACC (Day 1, 1 hour (±10 minutes), 2 hours (±10 minutes), 4 (±0.5) hours, 6 (±0.5) hours [and 8 (±0.5) hours if the subject is not discharged^{**}] post dose)
- Clinical laboratory tests (Day 1, 6 (±0.5) hours post dose and Day 8 (±1 day))
- Reproductive hormone assessments (Day 1, 6 (±0.5) hours post dose and Day 8 (±1 day))
- Injection site reaction assessment (Day 1, 1 hour (±10 minutes), 6 (±0.5) hours [and 8 (±0.5) hours if the subject is not discharged^{**}] post dose, Day 2 (24 (±4) hours), Day 3 (48 (±4) hours), and Day 8 (±1 day))
- Safety follow-up contact (Day 2 (24 (±4) hours), Day 3 (48 (±4) hours)) either by telephone or in person at the investigator's discretion
- Immunogenicity assessment (Day 8 (±1 day))
- Menstrual cycle history (Day 8 (±1 day) (in pubertal/postpubertal females))
- Recording of concomitant medications
- Assessment of adverse events

*A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score = zero, denoting the absence of symptoms).

If this is the case, the assessments scheduled for 8 hours post treatment will be omitted with the exception of subject self-assessment of HAE-related pain using the e-diary FPS-R.

**If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score \neq zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at both 6 AND 8 hours post treatment.

***If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score \neq zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at either 6 OR 8 hours post treatment.

8.4.2 Follow-up Visit (Day 90 \pm 7 days)

- Physical examination
- Vital signs
- Height and weight
- Clinical laboratory tests (serum chemistry, hematology, and urinalysis)
- Urine pregnancy test (in females of childbearing potential)
- Reproductive hormone assessments
- Immunogenicity assessment
- Menstrual cycle history (in pubertal/postpubertal females)
- Recording of concomitant medications
- Assessment of adverse events
- Documentation of HAE attack(s) not treated with icatibant

8.4.3 Telephone Contact (Month 6 \pm 7 days)

The scheduled telephone contact will document pubertal changes/milestones, if any.

- Pubarche
- Menarche (females only)
- Changes in menstrual cycle (females only)
- Pregnancy (females and male partner)

9 QUALITY CONTROL AND ASSURANCE

Training will occur at an investigator meeting or at the site initiation visit or both, and instruction manuals will be provided to aid consistency in data collection and reporting across sites.

Clinical sites will be monitored by the sponsor or its designee to ensure the accuracy of data against source documents.

The required data will be captured in a validated clinical data management system that is compliant with the Food and Drug Administration (FDA) 21 Code of Federal Regulations (CFR) Part 11 Guidance. The clinical trial database will include an audit trail to document any evidence of data processing or activity on each data field by each user. Users will be trained and given restricted access, based on their role(s) in the study, through a password-protected environment.

Data entered in the system will be reviewed manually for validity and completeness against the source documents by a clinical monitor from the sponsor or its designee. If necessary, the study site will be contacted for corrections or clarifications; all missing data will be accounted for.

Serious adverse event information captured in the clinical trial database will be reconciled with the information captured in the Pharmacovigilance database.

10 PLANNED STATISTICAL METHODS

10.1 General Considerations

All statistical analyses will be performed using SAS® statistical software (SAS Institute, North Carolina, USA). Data will be summarized with respect to disposition, demographic, pretreatment characteristics, PK variables, safety variables, and efficacy variables. Unless stated otherwise, tabular summaries will be presented by the subject's stratification group at enrollment (ie, prepubertal group, pubertal/postpubertal group, and the overall subjects group).

Summary statistics for continuous variables will include the number of subjects, the mean, median, standard deviation, and range. For PK parameters, the coefficient of variation and geometric mean also will be provided. For categorical data, summaries will include counts and percentages. For time to event data, the median time to event and other summary statistics will be estimated using the method of Kaplan and Meier.

10.2 Determination of Sample Size

The study will enroll a sufficient number of children and adolescents to ensure study completion of 36 evaluable subjects. The study population is planned to consist of at least 16 prepubertal and 20 pubertal/postpubertal subjects from 2 through 17 years of age who present with an acute cutaneous, abdominal, or laryngeal HAE attack. Though empirically derived and not based on a formal sample size calculation, this sample size will provide basic information concerning the PK, tolerability and safety, and efficacy of icatibant in children and adolescents with HAE.

10.3 Analysis Populations

The following populations will be used in the analysis:

- The Initial Non-laryngeal Treatment Population will consist of those subjects who were treated with icatibant for their initial attack and whose primary symptom was either cutaneous or abdominal.
- The Second Non-laryngeal Treatment Population will consist of those subjects who had a second icatibant-treated attack for which the primary symptom was either cutaneous or abdominal, regardless of the primary symptom for the initial attack.
- The Third Non-laryngeal Treatment Population will consist of those subjects who had a third icatibant-treated attack, for which the primary symptom was either cutaneous or abdominal, regardless of the primary symptom for the initial attack.
- The Laryngeal Population will consist of those subjects who were treated with icatibant for any attack for which the primary symptom was laryngeal.
- The PK Population will consist of those subjects who were treated with icatibant for their initial attack and who had at least 1 post-treatment icatibant concentration recorded.
- The Initial Treatment Population will consist of those subjects who were treated with icatibant for the initial attack.
- The Additional Treatment Population will consist of those pubertal/post-pubertal subjects who were treated with icatibant for more than 1 attack.

All efficacy analysis will be performed on the Initial Non-laryngeal Treatment Population, the Second Non-laryngeal Treatment Population, and the Third Non-laryngeal Treatment Population. The PK analyses will be based on the PK population. Safety and tolerability analyses will be based on the Initial Treatment Population and the Additional Treatment Population. The Laryngeal Population will be used to explore the efficacy of icatibant for the treatment of laryngeal attacks. All analyses conducted with this population will be limited to data corresponding to the subject's first laryngeal attack.

10.4 Demographics and Baseline Characteristics

Demographic data and pretreatment characteristics will be summarized for each analysis population.

10.5 Pharmacokinetic Analysis

A primary objective of the study is to investigate the PK of a single SC injection of icatibant in pediatric subjects treated for acute attacks of HAE. All PK analyses will use the PK population.

Plasma concentrations of icatibant and metabolites (ie, M1 and M2) and actual blood sampling times will be listed by subject and sampling time. Plasma concentrations will be summarized using descriptive statistics (number, mean and standard deviation). PK parameters for icatibant and metabolites will be listed by subject and will be summarized using descriptive statistics (number, mean, standard deviation, coefficient of variation, geometric mean, minimum, median, maximum). Individual and mean plasma concentrations of icatibant and metabolites versus time will be displayed on linear and semi-logarithmic axes.

10.5.1 Estimation of PK Parameters

Noncompartmental modeling: for subjects in whom the number of samples is sufficient to permit noncompartmental modeling, individual and mean PK parameters will be computed for icatibant and metabolites (M1 and M2) using standard noncompartmental methods, where possible, using the WinNonLin software package (Pharsight Corp., Mountain View, CA). For descriptive statistical tabulation of mean plasma concentrations and graphical displays, nominal collection times will be used, while all PK analysis and parameter calculations will use actual collection times. Plasma concentrations <LOQ will be treated as 0 for the calculation of the descriptive statistics for plasma concentrations at each sampling time. For the pharmacokinetic analysis, plasma concentrations <LOQ that occurred from pre-dose to the first concentration \geq LOQ will be treated as 0 and those that occur thereafter will be treated as missing.

PK parameter estimates will include, where appropriate: icatibant and metabolite concentrations at each sampling time, time to peak concentration (T_{max}), actual peak (C_{max}) and minimum (C_{min}) concentrations, clearance (CL/F), area under the plasma concentration-time curve (AUC_{0-last} and AUC_{0-inf}), mean residence time (MRT), volume of distribution at steady state (V_{ss}/F) and elimination half-life ($t_{1/2}$).

The distribution of continuous data will be evaluated using parametric tests. A transformation, such as logs, will be used where appropriate. Multiple regression analysis, with an appropriate transformation on the dependent variable, will be used to assess the contribution of potential PK covariates while controlling for demographic covariates (eg, subject's age and gender) to the inter-subject variability of icatibant PK parameters. The multivariable analysis will be considered the primary statistical analysis. A p-value of 0.05 will be considered statistically significant for all analyses.

Compartmental modeling using population methods: nonlinear mixed effects modeling will be used to define individual subject profiles and if possible, parameter estimates. The structural PK model will be developed and validated using PK information obtained from adult subjects and will enable delineation of the impact of age-dependent changes on icatibant disposition. Development of this model will allow for characterization and better prediction of the dose-concentration-exposure relationship for icatibant in pediatric subjects. Population PK modeling will be performed with nonlinear mixed effect modeling software (eg, NONMEM, Globomax LLC or WinNonMix, Pharsight Corp.). The program will estimate the inter- and intra-individual variability of PK parameter estimates. Both weight-normalization and allometric scaling principles will be evaluated. For selecting preliminary meaningful covariates the general additive model (GAM) analysis will be used. Variables to be considered will include (but are not limited to): age, sex, ethnicity, total and lean bodyweight (TBW, LBW), body mass index (BMI), and body surface area (BSA).

Monte Carlo simulation experiments based on the model(s) developed above may be performed by a validated simulation software program (eg, Trial Simulator, Pharsight Corp.) to assess the response patterns for various dosage regimens of icatibant treatments in the pediatric population.

10.6 Safety and Tolerability Analysis

Another primary objective of the study is to investigate the safety and tolerability of a single SC dose of icatibant in pediatric subjects with HAE during an acute HAE attack. The corresponding analyses will be based on the Initial Treatment Population.

The safety and tolerability parameters include adverse events, vital signs, ECG, local tolerability at the injection site, reproductive hormone levels, immunogenicity, and standard hematology, serum chemistry, and urinalysis.

Adverse events will be categorized using MedDRA Version 8.1 or higher. The assessment of safety will be based mainly on the frequency of treatment emergent adverse events. Adverse events will be summarized by system organ class (SOC) and preferred term. The number and proportion of subjects experiencing an adverse event will be tabulated by the subject stratification group and for the overall subject group. Adverse events by SOC and preferred term also will be tabulated by severity and by relationship to treatment. In the case of multiple occurrences of the same adverse events (at the preferred term level) in an individual subject, the adverse event that is classified as the most severe (ie, maximum severity) will be identified for the analysis by severity and the adverse event that has the highest relationship to investigational product will be identified for the analysis by relationship. Serious adverse events will be provided in a data listing.

Laboratory data will be listed by subject and stratification group. Subjects with newly occurring abnormalities outside the normal range will be flagged and listed separately. Actual values and mean change from pretreatment values will be summarized by the stratification group. Shift tables will also be tabulated by stratification group and time point.

Vital signs data will be listed by subject and stratification group. Furthermore, actual values and mean changes from baseline will be summarized for each stratification group as well as the overall subject group. Shift tables may be presented, utilizing reference ranges. Subjects with notably abnormal values will be identified and listed separately along with their values.

Local tolerability will be tabulated and summarized according to the type and severity of attack.

The impact of icatibant on the reproductive hormone levels will be assessed by presenting tabular summaries for FSH, LH, estradiol, and progesterone for females, and FSH, LH, and testosterone for males. The change from baseline values will also be summarized. Subjects with newly occurring abnormalities outside the normal range will be flagged and listed separately.

Data from other tests (eg, immunogenicity, ECG) will be listed and summarized as appropriate.

The assessment of safety and tolerability after repeated treatment with icatibant is also of interest. The analyses described above will be repeated using the Additional Treatment Population. The summary tables and listings will be presented by attack number (ie, Attack 1, Attack 2, and Attack 3).

10.7 Efficacy Analysis

The primary efficacy endpoint is the time to onset of symptom relief measured using the investigator-reported symptom score. The investigator will report symptom scores at pretreatment and 1, 2, 4, and 6 hours post treatment, and at 8 hours post treatment for subjects who had not shown complete resolution of HAE symptoms at 6 hours. Eight symptoms will be assessed for abdominal and cutaneous attacks, and 13 symptoms will be assessed for laryngeal attacks. Time of symptom relief is defined as the earliest time post treatment at which there is a 20% improvement in the average post-treatment symptom score with no worsening of any single component score. The median time and the 95% confidence interval will be calculated using the Kaplan-Meier methodology.

A tabular summary of the average investigator-reported symptom score and the change from baseline in the average investigator-reported symptom score will be presented by the stratification group and the overall subjects group. An alternative analysis of time to onset of symptom relief will focus on the time to minimal symptoms. In this case, symptom relief is defined as the earliest time post treatment when all symptoms are either absent or mild.

For individual investigator-reported symptom scores, a shift table from baseline will be presented for each post-treatment time point. The analysis will be repeated to assess shift in the individual symptom scores from the 2 hour time-point. Also, for individual symptoms that are moderate or worse at pretreatment, the median and 95% confidence interval will be presented for the time to the symptom being mild or absent.

Two subsets of subjects, those 4 years of age or older and those below 4 years of age, will assess pain using the FPS-R and FLACC instruments, respectively. Time to onset of symptom relief will be computed in a manner similar to that for the average investigator-reported symptom scores.

All efficacy analysis will be performed on the initial treatment population, the second treatment population, and the third treatment population. The efficacy data for subjects with laryngeal attacks will be listed. If there are at least 5 subjects with laryngeal attacks, then the average investigator-reported symptom scores and the change from baseline in the average investigator-reported symptom score will be summarized. Additionally, time to symptom relief analysis will be performed on the investigator-reported symptom scores.

10.8 Other Analyses

The number and percentage of subjects who received rescue medications before the onset of symptom relief will be summarized by the stratification group. Time to first use of rescue medication prior to symptom relief will be calculated from the time of investigational product administration to the first use of rescue medication prior to symptom relief. The median time and the 95% confidence interval will be calculated using Kaplan-Meier methodology if there are at least 5 subjects who used rescue medication prior to attaining symptom relief.

10.9 Data Monitoring and Interim Analysis

A Data and Safety Monitoring Board (DSMB) will be set up to review the safety, tolerability, PK, and efficacy data on an ongoing basis. Y Y Y Y Yr-g; its goal will be to assess the risk/benefit of icatibant treatment in this pediatric population. An analysis of the data for DSMB review is planned after the first 4 subjects in the pubertal/postpubertal group have been treated, and is planned to follow quarterly enrollment milestones (ie, 25%, 50%, and 75%) thereafter. Because no formal hypothesis testing is planned, multiplicity concerns regarding repeated analyses are not an issue.

10.10 Handling of Missing Data

Individual pretreatment symptom scores, FPS-R scores, and FLACC scores will be assigned a value of zero. For missing post-treatment scores, imputation will be employed using the Last Observation Carried Forward (LOCF) approach. The pretreatment values may also be used in the imputation. For missing or partial rescue medication dates, the imputation will be performed such that the earliest possible time post treatment will be assigned to the rescue medication use. A similar approach will be followed in case of missing or partial adverse event dates.

11 ADMINISTRATIVE CONSIDERATIONS

11.1 Investigators and Study Administrative Structure

Before initiation of the study, the investigator must provide the sponsor with a completed Form FDA 1572. Investigational product may be administered only under the supervision of the investigator listed on this form. Curriculum vitae must be provided for the investigator and sub-investigators listed on Form FDA 1572.

The investigator should ensure that all persons assisting with the study are adequately informed about the protocol, any amendments to the protocol, the study treatments, and their study related duties and functions. The investigator must maintain a list of sub-investigators and other appropriately qualified persons to whom he or she has delegated significant study related duties.

11.2 Institutional Review Board or Independent Ethics Committee Approval

Before initiation of the study, the investigator must provide the sponsor with a copy of the written IRB/IEC approval of the protocol and the informed consent form. This approval must refer to the informed consent form and to the study title, study number, and version and date of issue of the study protocol, as given by the sponsor on the cover page of the protocol.

Status reports must be submitted to the IRB/IEC at least once per year. The IRB/IEC must be notified of completion of the study. Within 3 months of study completion or termination, a final report must be provided to the IRB/IEC. A copy of these reports will be sent to the study clinical monitor. The investigators must maintain an accurate and complete record of all submissions made to the IRB/IEC, including a list of all reports and documents submitted. AEs which are reported to the US Food and Drug Administration (FDA) or other Regulatory agencies (Investigational New Drug [IND] Safety Reports) must be submitted promptly to the IRB/IEC.

11.3 Ethical Conduct of the Study

The procedures set out in this study protocol, pertaining to the conduct, evaluation, and documentation of this study, are designed to ensure that the sponsor and investigators abide by good clinical practice (GCP) as described in the 21 CFR Parts 50, 56, and 312 and the International Conference on Harmonisation (ICH) GCP Guidelines. Compliance with these regulations and guidelines also constitutes compliance with the ethical principles described in the Declaration of Helsinki.

11.4 Subject Information and Consent/Assent

Before enrolling in the clinical study, the subject and/or the subject's parent(s) or legal guardian(s) as appropriate must consent to participate after the nature, scope, and possible consequences of the clinical study have been explained in a form understandable to him or her.

An informed consent form (assent form if applicable) that includes information about the study will be prepared and given to the subject or the subject's parent(s) or legal guardian(s).

This document will contain all FDA and ICH-required elements, as well as other elements required by ethics committees, if applicable, or as per country legal requirements. The informed consent (or assent form, if applicable) form must be in a language understandable to the subject or the subject's parent(s) or legal guardian(s) and must specify who informed the subject, the subject's parent(s), or the subject's legal guardian(s).

After reading the informed consent document, the subject or the subject's parent(s) or legal guardian(s) must give consent in writing. Consent must be confirmed at the time of consent by the personally dated signature of the subject, the subject's parent(s) or the subject's legal guardian(s) and by the personally dated signature of the person conducting the informed consent discussions.

If the subject or the subject's parent(s) or legal guardian(s) is unable to read, oral presentation and explanation of the written informed consent form and information to be supplied must take place in the presence of an impartial witness. Consent must be confirmed at the time of consent orally and by the personally dated signature of the subject or by a local legally recognized alternative (eg, the subject's thumbprint or mark) or by the personally dated signature of the subject's parent(s) or the subject's legal guardian(s). The witness and the person conducting the informed consent discussions must also sign and personally date the informed consent document. It should also be recorded and dated in the source document that consent was given.

A copy of the signed and dated consent document(s) must be given to the subject or the subject's parent(s) or the subject's legal guardian(s). The original signed and dated consent document will be retained by the investigator.

The investigator will not undertake any measures specifically required solely for the clinical study until valid consent has been obtained.

A model of the informed consent form to be used in this study will be provided to the sites separately from this protocol.

11.5 Subject Confidentiality

Subject names will not be supplied to the sponsor. Only the subject number and subject initials will be recorded in the CRF, if applicable according to local laws and regulation, and if the subject name appears on any other document, it must be obliterated before a copy of the document is supplied to the sponsor. Study findings stored on a computer will be stored in accordance with local data protection laws. The subjects will be told that representatives of the sponsor, a designated CRO, the IRB/IEC, or regulatory authorities may inspect their medical records to verify the information collected, and that all personal information made available for inspection will be handled in strictest confidence and in accordance with local data protection laws. The investigator will maintain a personal subject identification list (subject numbers with the corresponding subject names) to enable records to be identified.

11.6 Study Monitoring

Monitoring procedures that comply with current GCP guidelines will be followed. Review of the CRFs for completeness and clarity, cross-checking with source documents, and clarification of administrative matters will be performed.

The study will be monitored by the sponsor or its designee. Monitoring will be performed by a representative of the sponsor (Clinical Study Monitor) who will review the CRFs and source documents. The site monitor will ensure that the investigation is conducted according to protocol design and regulatory requirements by frequent site visits and communications (letter, email, telephone, and facsimile).

11.7 Case Report Forms and Study Records

Case report forms (paper or electronic) are provided for each subject. All forms must be filled out by authorized study personnel. All corrections to the original CRF entry must indicate the reason for change. The investigator is required to sign the CRF after all data have been captured for each subject. If corrections are made after review and signature by the investigator, he or she must be made aware of the changes, and his or her awareness documented by resigning the CRF.

11.7.1 Critical Documents

Before the sponsor initiates the trial (ie, obtains informed consent from the first subject), it is the responsibility of the investigator to ensure that the following documents are available to the sponsor or its designee:

- Completed FDA Form 1572 (Statement of Investigator), signed, dated, and accurate.
- Curricula vitae of investigator and sub-investigator(s) (current, dated and signed within 24 months of study initiation).
- Copy of investigator(s) and sub-investigator(s) current medical license (indicating license number and expiration date).
- Signed and dated agreement of the final protocol.
- Signed and dated agreement of any amendment(s), if applicable.
- Approval/favorable opinion from the IRB/IEC clearly identifying the documents reviewed by name, number and date of approval or re approval: protocol, any amendments, Subject Information/Informed Consent Form, and any other written information to be provided regarding subjects recruitment procedures.
- Copy of IRB/IEC approved Subject Information/Informed Consent Form/any other written information/advertisement (with IRB approval stamp and date of approval).
- Current list of IRB/IEC Committee members/constitution (dated within 12 months prior to study initiation).
- Financial Disclosure Form signed by investigator(s) and sub-investigator(s).
- Current laboratory reference ranges (if applicable).
- Certification/QA scheme/other documentation (if applicable).

Regulatory approval and notification as required must also be available; these are the responsibility of the sponsor.

11.8 Data and Safety Monitoring Board

In view of the role of bradykinin and B2 receptors in reproductive development, the study will use an external Data and Safety Monitoring Board (DSMB). The DSMB will provide an ongoing, independent review and assessment of the safety data to protect the interests and safety of subjects participating in the study. The DSMB will adhere to a prospectively determined charter which will be proposed by sponsor and approved by the DSMB. The charter will define the membership of the DSMB, the responsibilities of the DSMB and the sponsor, describe the conduct of meetings, and define the data to be reviewed.

Enrollment of pediatric subjects in the proposed study will be stratified into 2 groups (2 years of age to the older prepubertal children, and pubertal/postpubertal children to those 17 years of age). It is planned that subjects in both groups will receive an icatibant dose (0.4 mg/kg to a maximum dose of 30 mg) selected to target an exposure comparable to that observed in adults treated with icatibant. Initially, enrollment and dosing of pubertal/postpubertal subjects will precede that of prepubertal subjects. After the first 4 subjects in the pubertal/postpubertal group have been treated, icatibant concentration measurements and PK analysis, safety, tolerability, and efficacy data will be reviewed and assessed by the DSMB. This review must be completed prior to initiating enrollment of subjects in the prepubertal group. As the outcome of its review, the DSMB may make a recommendation to continue enrolling subjects in the pubertal/postpubertal group, to initiate dosing of subjects in the prepubertal group, or to administer a different dose, or to terminate the study.

11.9 Protocol Violations/Deviations

The investigator will conduct the study in compliance with the protocol. The protocol will not be initiated until the IRB/IEC and the appropriate regulatory authorities have given approval/favorable opinion. Modifications to the protocol will not be made without agreement of the sponsor. Changes to the protocol will require written IRB/IEC approval/favorable opinion prior to implementation, except when the modification is needed to eliminate an immediate hazard(s) to subjects. The IRB/IEC may provide, if applicable regulatory authorities permit, expedited review and approval/favorable opinion for minor change(s) in ongoing studies that have the approval/favorable opinion of the IRB/IEC. The sponsor will submit all protocol modifications to the regulatory authorities in accordance with the governing regulations.

A record of subjects screened, but not entered into the study, is also to be maintained. No protocol waivers or exemptions will be considered by the sponsor during the study.

When immediate deviation from the protocol is required to eliminate an immediate hazard(s) to subjects, the investigator will contact the sponsor or its designee, if circumstances permit, to discuss the planned course of action.

Any departures from the protocol must be fully documented as a protocol deviation. Protocol deviations will need to be reviewed by the medical monitor and may also need to be submitted to the IRB/IEC.

Protocol modifications will only be initiated by the sponsor and must be approved by the IRB/IEC and submitted to the FDA or other applicable international regulatory authority before initiation.

11.10 Premature Closure of the Study

If the sponsor, investigator, or regulatory authorities discover conditions arising during the study which indicate that the clinical investigation should be halted due to an unacceptable risk to subjects, the study may be terminated after appropriate consultation between the sponsor and the investigator. In addition, a decision on the part of the sponsor to suspend or discontinue development of the investigational product may be made at any time. Conditions that may warrant termination of the study or site include, but are not limited to:

- The discovery of an unexpected, significant, or unacceptable risk to the subjects enrolled in the study.
- Failure of the investigator to comply with pertinent global regulations.
- Submission of knowingly false information from the study site to the sponsor or other pertinent regulatory authorities.
- Insufficient adherence by the Investigator to protocol requirements.

11.11 Access to Source Documentation

Regulatory authorities, the IRB/IEC, or the sponsor may request access to all source documents, CRFs, and other study documentation for on-site audit or inspection. Direct access to these documents must be guaranteed by the investigator, who must provide support at all times for these activities. Monitoring and auditing procedures that comply with current GCP guidelines will be followed. On-site review of the CRFs for completeness and clarity, cross-checking with source documents, and clarification of administrative matters may be performed.

11.12 Data Generation and Analysis

The clinical database will be developed and maintained by a contract research organization or an electronic data capture technology provider as designated by Shire HGT. The sponsor or its designee will be responsible for performing study data management activities.

Adverse events will be coded using Medical Dictionary for Regulatory Activities (MedDRA) Version 8.1 or higher. Concomitant medication will be coded using WHO-Drug Dictionary (2004, Q4). Centralized laboratories will be employed as described in the study manual to aid in consistent measurement of efficacy and safety parameters.

11.13 Retention of Data

Essential documents should be retained until at least 2 years after the last approval of a marketing application and until there are no pending or contemplated marketing applications or at least 2 years have elapsed since the formal discontinuation of clinical development of the investigational product. The sponsor will notify the investigator if these documents must be retained for a longer period of time. It is the responsibility of the sponsor to inform the Investigator or institution as to when these documents no longer need to be retained.

11.14 Financial Disclosure

The investigator should disclose any financial interests in the sponsor as described in 21 CFR Part 54 prior to beginning this study. The appropriate form will be provided to the investigator by the sponsor, which will be signed and dated by the investigator, prior to the start of the study, at the end of the study, and one year post-study (or site) closure.

11.15 Publication and Disclosure Policy

All information concerning the study material, such as patent applications, manufacturing processes, basic scientific data, and formulation information supplied by the sponsor and not previously published are considered confidential and will remain the sole property of the sponsor. The investigator agrees to use this information only in accomplishing this study and will not use it for other purposes.

It is understood by the investigator that the information developed in the clinical study may be disclosed as required to the authorized regulatory authorities and governmental agencies. In order to allow for the use of the information derived from the clinical studies, it is understood that there is an obligation to provide the sponsor with complete test results and all data developed in the study in a timely manner.

The investigator and any other clinical personnel associated with this study will not publish the results of the study, in whole or in part, at any time, unless they have consulted with Shire HGT, provided Shire HGT a copy of the draft document intended for publication, and obtained the written consent of Shire HGT for such publication. All information obtained during the conduct of this study will be regarded as confidential. Shire HGT will use the information for registration purposes and for the general development of the drug.

12 LIST OF REFERENCES

1. Bowen T, Cicardi M, Bork K, et al. Hereditary angioedema: a current state-of-the-art review, VII: Canadian Hungarian 2007 International Consensus Algorithm for the Diagnosis, Therapy, and Management of Hereditary Angioedema. *Annals of Allergy Asthma Immunology* 2008;100:S30-40.
2. Davis AE, 3rd. New treatments addressing the pathophysiology of hereditary angioedema. *Clinical and Molecular Allergy* 2008;6:2.
3. Knolle J, Breipohl G, Henke S, Wirth K, Scholkens B. New and highly potent bradykinin antagonists. *Agents and Actions Supplement* 1992;38 (Part 1):559-64.
4. Hock FJ, Wirth K, Albus U, et al. Hoe 140 a new potent and long acting bradykinin-antagonist: in vitro studies. *British Journal of Pharmacology* 1991;102:769-73.
5. Wirth K, Hock FJ, Albus U, et al. HOE 140 a new potent and long acting bradykinin-antagonist: in vivo studies. *British Journal of Pharmacology* 1991;102:774-7.
6. Farkas H. Pediatric hereditary angioedema due to C1-inhibitor deficiency. *Allergy, Asthma and Clinical Immunology* 2010;6:18.
7. Zuraw BL. Clinical practice. Hereditary angioedema. *New England Journal of Medicine* 2008;359:1027-36.
8. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. *Archives of Disease in Childhood* 1969;44:291-303.
9. Marshall WA, Tanner JM. Variations in the pattern of pubertal changes in boys. *Archives of Disease in Childhood* 1970;45:13-23.
10. Bieri D, Reeve RA, Champion GD, Addicoat L, Ziegler JB. The Faces Pain Scale for the self-assessment of the severity of pain experienced by children: development, initial validation, and preliminary investigation for ratio scale properties. *Pain* 1990;41:139-50.
11. Hicks CL, von Baeyer CL, Spafford PA, van Korlaar I, Goodenough B. The Faces Pain Scale-Revised: toward a common metric in pediatric pain measurement. *Pain* 2001;93:173-83.
12. Manworren RC, Hynan LS. Clinical validation of FLACC: preverbal patient pain scale. *Pediatric Nursing* 2003;29:140-6.
13. Merkel SI, Voepel-Lewis T, Shayevitz JR, Malviya S. The FLACC: a behavioral scale for scoring postoperative pain in young children. *Pediatric Nursing* 1997;23:293-7.

Appendix 1 Study Schedule of Events (Initial Icatibant-treated Attack)

Initial Icatibant-treated Attack (All Subjects)	Screening Period	Pre-treatment (Baseline)	Treatment	Post Treatment											Follow-up	
				Day 1											Day 2	Day 3
Study Day		Day 1	Day 1	0.25	0.5	0.45	1	2	4	6	8 ^e	24	48			
Time Post Treatment (hours)			0	(±5) min	(±5) min	(±5) min	(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr			
Window (hours or minutes)																
Assessments																
Informed Consent/Assent	X															
Medical History	X	X														
Documentation of HAE Attack(s) Not Treated with icatibant															X	
Documentation of Pubertal Changes/Milestones																X
Confirm Documented Diagnosis (HAE)	X															
C1-INH Assessment	X															
Inclusion/Exclusion Assessment	X	X ^a														
Physical Examination	X	X								X ^g	X ^g			X	X	

Initial Icatibant-treated Attack (All Subjects)	Screening Period	Pre-treatment (Baseline)	Treatment	Post Treatment											Follow-up	
															Month 6 (± 7 days) Telephone Contact	
Study Day		Day 1	Day 1	Day 1								Day 2	Day 3	Day 8 (±1)	Day 90 (±7)	
Time Post Treatment (hours)			0	0.25	0.5	0.45	1	2	4	6	8 ^e	24	48			
Window (hours or minutes)				(±5) min	(±5) min	(±5) min	(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr			
Assessments																
Pubertal Status Determination ^b	X	X														
Menstrual Cycle History (in pubertal/postpubertal females)		X												X	X	
Vital Signs	X	X					X			X ^g	X ^g			X	X	
ECG	X									X ^g	X ^g					
Height and Weight	X	X													X	
Subject Self-assessment of HAE-related Pain Using e-diary FPS-R (in subjects 4 years of age and older, and before blood work, if applicable)		X					X	X	X	X ^f	X ^{e,f}	X	X			
Investigator Assessment of HAE Symptoms		X					X	X	X	X ^f	X ^f					

Initial Icatibant-treated Attack (All Subjects)	Screening Period	Pre-treatment (Baseline)	Treatment	Post Treatment											Follow-up				
				Day 1											Day 2	Day 3	Day 8 (±1)	Day 90 (±7)	Month 6 (± 7 days) Telephone Contact
Study Day		Day 1	Day 1	Day 1											Day 2	Day 3	Day 8 (±1)	Day 90 (±7)	
Time Post Treatment (hours)			0	0.25	0.5	0.45	1	2	4	6	8 ^e	24	48						
Window (hours or minutes)				(±5) min	(±5) min	(±5) min	(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr						
Assessments																			
Investigator Assessment of HAE-related Pain Using FLACC (in subjects younger than 4 years of age, and before blood work, if applicable)		X					X	X	X	X ^f	X ^f								
Clinical Laboratory Tests (serum chemistry, hematology, urinalysis)		X								X				X	X				
Urine Pregnancy Test (in females of childbearing potential)	X	X													X				
Reproductive Hormone Assessments (FSH, LH, estradiol, progesterone in females; FSH, LH, testosterone in males)		X								X				X	X				

Initial Icatibant-treated Attack (All Subjects)	Screening Period	Pre-treatment (Baseline)	Treatment	Post Treatment											Follow-up	
				Day 1											Day 2	Day 3
Study Day		Day 1	Day 1	0.25	0.5	0.45	1	2	4	6	8 ^e	24	48			
Time Post Treatment (hours)			0	(±5) min	(±5) min	(±5) min	(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr			
Window (hours or minutes)																
Assessments																
Investigational Product Administration (single SC dose)			X													
Safety Follow-up Contact												X ^c	X ^c			
Injection Site Reaction Evaluation							X			X ^f	X ^f	X ^c	X ^c	X		
PK Sampling ^d		X		X	X	X	X	X	X	X						
Immunogenicity Evaluation		X												X	X	
Concomitant Medications	X	X	X	X	X	X	X	X	X	X ^f	X ^f	X ^c	X ^c	X	X	
Adverse Events			X	X	X	X	X	X	X	X ^f	X ^f	X ^c	X ^c	X	X	

Initial Icatibant-treated Attack (All Subjects)	Screening Period	Pre-treatment (Baseline)	Treatment	Post Treatment											Follow-up	
															Month 6 (± 7 days) Telephone Contact	
Study Day		Day 1	Day 1	Day 1								Day 2	Day 3	Day 8 (±1)	Day 90 (±7)	
Time Post Treatment (hours)			0	0.25	0.5	0.45	1	2	4	6	8 ^e	24	48			
Window (hours or minutes)				(±5) min	(±5) min	(±5) min	(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr			
Assessments																

Abbreviations: FLACC = Faces, Legs, Activity, Cry, and Consolability (comportmental pain scale); FPS-R = Faces Pain Scale-Revised; FSH = follicle stimulating hormone; HAE = hereditary angioedema; hr = hour; LH = luteinizing hormone min = minute; PK = pharmacokinetic; SC = subcutaneous

^a The inclusion/exclusion criteria will be confirmed at the Pretreatment (Baseline) Visit.

^b A subject's classification as prepubertal or pubertal/postpubertal will be determined at the Day 1 pretreatment visit. Note that a subject classified as pubertal/postpubertal at screening will not require further evaluation of pubertal status during the study.

^c These assessments will be conducted either by telephone contact or in person at the discretion of the investigator.

^d The PK sampling times shown are for pubertal/postpubertal subjects. Prepubertal subjects will have blood samples drawn on Day 1 prior to dosing and at 15 (±5) minutes, 30 (±5) minutes, 2 hours (±10 minutes), 4 (±0.5) hours, and 6 (±0.5) hours post dose as indicated in Section 8.3.1.

^e A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score = zero, denoting the absence of symptoms). If this is the case, the assessments scheduled for 8 hours post treatment will be omitted with the exception of subject self-assessment of HAE-related pain using the e-diary FPS-R.

^f If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at both 6 AND 8 hours post treatment.

^g If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at either 6 OR 8 hours post treatment.

Appendix 2 Study Schedule of Events (Subsequent Icatibant-treated Attacks)

Subsequent Icatibant-treated Attacks (Pubertal/postpubertal subjects only)	Pre-treatment (Baseline) ^g	Treatment	Post Treatment							Follow-up	
			Day 1					Day 2	Day 3	Day 8 (±1) ^a	Day 90 (±7) ^a
Study Day	Day 1	Day 1	1	2	4	6	8 ^d	24	48		
Time Post Treatment (hours)		0	1	2	4	6	8 ^d	24	48		
Window (hours or minutes)			(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr		
Assessments											
Inclusion/Exclusion Assessment	X										
Physical Examination	X					X ^f	X ^f			X	X
Pubertal Status Determination ^b	X										
Menstrual Cycle History (in pubertal/postpubertal females)	X									X	X
Documentation of HAE Attack(s) Not Treated with icatibant											X
Documentation of Pubertal Changes/Milestones											X
Vital Signs	X		X			X ^f	X ^f			X	X
ECG	X					X ^f	X ^f				
Height and Weight	X										X
Subject Self-assessment of HAE-related Pain Using e-diary FPS-R (in subjects 4 years of age and older, and before blood work, if applicable)	X		X	X	X	X ^e	X ^{d,e}	X	X		

Subsequent Icatibant-treated Attacks (Pubertal/postpubertal subjects only)	Pre-treatment (Baseline) ^g	Treatment	Post Treatment								Follow-up	
			Day 1					Day 2	Day 3	Day 8 (±1) ^a	Day 90 (±7) ^a	Month 6 (± 7 days) Telephone Contact
Study Day	Day 1	Day 1	Day 1					Day 2	Day 3	Day 8 (±1) ^a	Day 90 (±7) ^a	
Time Post Treatment (hours)		0	1	2	4	6	8 ^d	24	48			
Window (hours or minutes)			(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr			
Assessments												
Investigator Assessment of HAE Symptoms	X		X	X	X	X ^e	X ^e					
Investigator Assessment of HAE-related Pain using FLACC (in subjects younger than 4 years of age, and before blood work, if applicable)	X		X	X	X	X ^e	X ^e					
Clinical Laboratory Tests (serum chemistry/hematology/urinalysis)	X					X				X	X	
Urine Pregnancy Test (in females of childbearing potential)	X										X	
Reproductive Hormone Assessments (FSH, LH, estradiol, progesterone in females; FSH, LH, testosterone in males)	X					X				X	X	
Safety Follow-up Contact								X ^c	X ^c			
Investigational Product Administration (single SC injection)		X										
Injection Site Reaction Evaluation			X			X ^e	X ^e	X ^c	X ^c	X		
Immunogenicity Evaluation	X									X	X	
Concomitant Medications	X	X	X	X	X	X ^e	X ^e	X ^c	X ^c	X	X	

Subsequent Icatibant-treated Attacks (Pubertal/postpubertal subjects only)	Pre-treatment (Baseline) ^g	Treatment	Post Treatment								Follow-up	
			Day 1					Day 2	Day 3	Day 8 (±1) ^a	Day 90 (±7) ^a	Month 6 (± 7 days) Telephone Contact
Study Day	Day 1	Day 1	Day 1					Day 2	Day 3	Day 8 (±1) ^a	Day 90 (±7) ^a	
Time Post Treatment (hours)		0	1	2	4	6	8 ^d	24	48			
Window (hours or minutes)			(±10) min	(±10) min	(±0.5) hr	(±0.5) hr	(±0.5) hr	(±4) hr	(±4) hr			
Assessments												
Adverse Events	X	X	X	X	X	X ^e	X ^e	X ^c	X ^c	X	X	

Abbreviations: FLACC = Faces, Legs, Activity, Cry, and Consolability (comportmental pain scale); FPS-R = Faces Pain Scale-Revised; FSH = follicle stimulating hormone; HAE = hereditary angioedema; hr = hour; LH = luteinizing hormone; min = minute; SC = subcutaneous

^a If a subsequent attack occurs within 7 days of the Day 90 visit for the previous attack, the assessments on Day 8 and Day 90 will be combined.

^b A subject's classification as prepubertal or pubertal/postpubertal will be determined at the Day 1 pretreatment visit. Note that a subject classified previously as pubertal/postpubertal will not require further evaluation of pubertal status during the study.

^c These assessments will be conducted either by telephone contact or in person at the discretion of the investigator.

^d A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score = zero, denoting the absence of symptoms). If this is the case, the assessments scheduled for 8 hours post treatment will be omitted with the exception of subject self-assessment of HAE-related pain using the e-diary FPS-R.

^e If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at both 6 AND 8 hours post treatment.

^f If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated will be performed at either 6 OR 8 hours post treatment.

^g Subsequent treatment with icatibant for up to 2 additional attacks of acute HAE for a total of 3 attacks will be offered to pubertal/postpubertal subjects contingent upon having been treated for an initial attack and presenting with a subsequent acute attack at least 7 days after prior treatment. In the event that a subsequent attack occurs at least 7 days after prior treatment, but is within the window (±1 day) allowed for performance of Day 8 assessments associated with a prior attack, the Day 8 assessments may also serve as the pretreatment (baseline) assessments for the subsequent attack.

Appendix 3 Modified Sexual Maturation Scale

Stage	Female Breast Stage	Female Pubic Hair Stage ^a	Male Genital Stage	Male Pubic Hair Stage ^a
1 Preadolescent	Elevation of papilla only.	No pubic hair.	Testes, scrotum, and penis are of about the same size and proportion as in early childhood.	No pubic hair.
2	Breast bud stage; elevation of breast and papilla as a small mound, enlargement of areolar diameter.	Sparse growth of long, slightly pigmented downy hair, straight or only slightly curled, appearing on the pubis. Do not consider hair on the labia.	The scrotum and testes have enlarged and there is a change in the texture of the scrotal skin. There is also some reddening of the scrotal skin.	Sparse growth of long, slightly pigmented downy hair, straight or only slightly curled, appearing chiefly at the base of the penis.
3	Further enlargement of breast and areola, with no separation of their contours.	Considerably darker, coarser, and more curled; spreads sparsely over the conjunction of the pubes.	Growth of the penis has occurred, at first mainly in length but with some increase in breadth. There has been further growth of testes and scrotum.	Considerably darker, coarser, and more curled; spreads sparsely over the junction of the pubes.
4	Projection of areola and papilla to form a secondary mound above the level of the breast.	Hair is adult in type, but the area covered by it is still considerably smaller than in most adults. There is no spread to the medial surface of the thighs.	Penis further enlarged in length and breadth with development of glans. Testes and scrotum further enlarged. Further darkening of the scrotal skin.	Hair is adult in type, but the area covered by it is still considerably smaller than in most adults. There is no spread to the medial surface of the thighs.
5	Mature stage; projection of papilla only, owing to recession of the areola to the general contour of the breast.	Adult in quantity and type, distributed as an inverse triangle. Spread to the medial surface of the thighs, but not up the linea alba or elsewhere above the base of the inverse triangle.	Genitalia adult in size and shape. No further enlargement takes place after stage 5 is reached.	Adult in quantity and type, distributed as an inverse triangle. Spread to the medial surface of the thighs, but not up the linea alba or elsewhere above the base of the inverse triangle.
^a Pubic hair development reflects adrenal function, not hypothalamic/gonadal function. The descriptions used in this table are intended to provide guidance for the investigators and may not align with descriptions of pubic hair and pubertal stage in other sources.				

Appendix 4 Faces Pain Scale-Revised (FPS-R)

Faces Pain Scale – Revised (FPS-R)

From *Pediatric Pain Sourcebook*, www.painsourcebook.ca
Version: 7 Aug 2007 CL von Baeyer

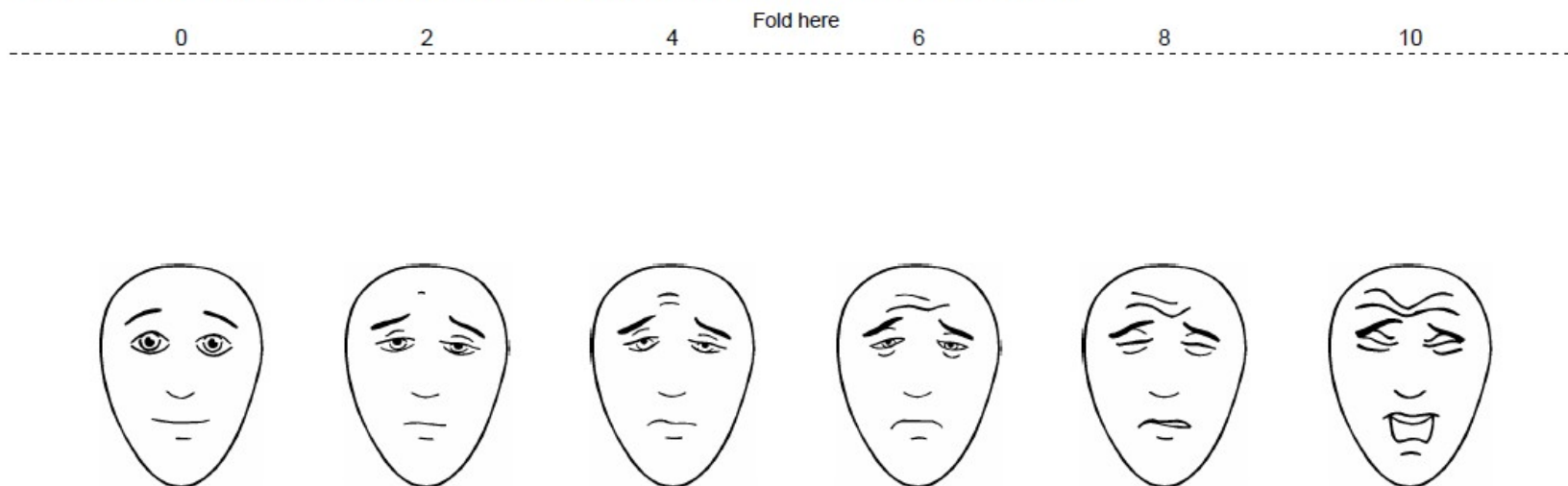
In the following instructions, say "hurt" or "pain," whichever seems right for a particular child.

"These faces show how much something can hurt. This face [point to left-most face] shows no pain. The faces show more and more pain [point to each from left to right] up to this one [point to right-most face] – it shows very much pain. Point to the face that shows how much you hurt [right now]."

Score the chosen face 0, 2, 4, 6, 8, or 10, counting left to right, so '0' = 'no pain' and '10' = 'very much pain.' Do not use words like 'happy' and 'sad'. This scale is intended to measure how children feel inside, not how their face looks.

Permission for use. Copyright in the FPS-R is held by the International Association for the Study of Pain (IASP) © 2001. This material may be photocopied for non-commercial clinical and research use. To request permission from IASP to reproduce the FPS-R in a publication, or for any commercial use, please e-mail iaspdesk@iasp-pain.org For all other information regarding the FPS-R contact Tiina.Jaaniste@sesiahs.health.nsw.gov.au (Pain Medicine Unit, Sydney Children's Hospital, Randwick NSW 2031, Australia).

Sources. Hicks CL, von Baeyer CL, Spafford P, van Korlaar I, Goodenough B. The Faces Pain Scale – Revised: Toward a common metric in pediatric pain measurement. *Pain* 2001;93:173-183. Bieri D, Reeve R, Champion GD, Addicoat L, Ziegler J. The Faces Pain Scale for the self-assessment of the severity of pain experienced by children: Development, initial validation and preliminary investigation for ratio scale properties. *Pain* 1990;41:139-150.



Appendix 5 Faces, Legs, Activity, Cry, and Consolability Scale (FLACC)

FLACC SCALE (FACE, LEGS, ACTIVITY, CRY, CONSOLABILITY)			
FACE	0 No particular expression or smile	1 Occasional grimace or frown Withdrawn Disinterested	2 Frequent to constant frown Clenched jaw Quivering chin
LEGS	0 Normal position or Relaxed	1 Uneasy Restless Tense	2 Kicking or Legs drawn up
ACTIVITY	0 Lying quietly Normal position Moves easily	1 Squirming Shifting back/forth Tense	2 Arched Rigid or Jerking
CRY	0 No cry (awake or asleep)	1 Moans or whimpers Occasional complaint	2 Crying steadily Screams or sobs Frequent complaints
CONSOLABILITY	0 Content Relaxed	1 Reassured by occasional touching, hugging, or 'talking to'. Distractible	2 Difficult to console or comfort
<p>The FLACC is a behavioral pain assessment scale suitable for use in preverbal children and children with limited verbal capability.</p> <p><u>Instructions:</u></p> <ol style="list-style-type: none"> 1. Rate patient in each of the 5 measurement categories 2. Add together. 3. Document total pain score. 			

Appendix 6 Protocol Signature Page

Study Title: A Multicenter, Open-Label, Non-Randomized Study to Assess the Pharmacokinetics, Tolerability, and Safety of a Single Subcutaneous Administration of Icatibant in Children and Adolescents with Hereditary Angioedema

Study Number: HGT-FIR-086

Original Protocol Date: 14 June 2011

Amendment 1 Date: 05 August 2011

Amendment 2 Date: 06 March 2012

I have read the protocol described above. I agree to comply with all applicable regulations and to conduct the study as described in the protocol.

Signatory:

Investigator

Signature

Date

Printed Name

I have read and approve the protocol described above.

Signatory:

**Shire HGT
Medical
Monitor**

Signature

Date

PPD MD, PhD

Printed Name

Appendix 7 Summary of Changes for Amendment 2

1. Amendment Summary and Rationale

Protocol HGT-FIR-086 has been amended to incorporate feedback from investigators and institutional ethics committees. Operational clarifications to the text and changes to the study schedules of events were implemented to facilitate study conduct.

Noteworthy changes are as follows:

- Determination of Tanner stage was eliminated in favor of simply stratifying subjects by pubertal status (prepubertal [Tanner stage I] or pubertal/postpubertal [Tanner stages II to V] as defined by PDCO). An assessment of pubertal status was added at Screening to ensure that, as required by the DSMB, the first 4 subjects enrolled will be pubertal/postpubertal. It was also specified that subjects classified as pubertal/postpubertal at Screening would not require further evaluations or pubertal status during the study. Finally, the pubertal status assessment scheduled on Day 90 in previous versions of the protocol lacks a clear rationale and has been eliminated in this amended version.
- The duration of time over which blood samples for pharmacokinetic and other assessments are to be collected on the day of dosing was reduced from 8 to 6 hours to reduce the burden of study participation on subjects. Text was also added to encourage the use of an intravenous cannula for pharmacokinetic blood draws and to allow for the use of a topical anesthetic, as appropriate.
- Clarifications were made to inclusion criterion #2 pertaining to the definition of C1-INH deficiency and to ensure that the text is clear that though all subjects will have confirmatory C1-INH testing, the results are not predetermining for inclusion (due to the approximate 1-month turnaround time for test results) unless the patient does not have a previously documented diagnosis of HAE.
- Clarification to exclusion criterion #2 was made to ensure that the text clearly prohibits patients from participating in another concurrent interventional clinical study. Additionally, new exclusion criterion #9 was added to exclude subjects with a physical condition that interferes with pubertal status determination.
- The text was modified to reflect a change in the sponsor's medical monitor and contact information.
- A collection window was added around the Day 8 (± 1 day) visit, and it was specified that existing windows for pharmacokinetic assessments should be applied to other assessments performed at those time points.
- Collection of menstrual cycle history on Day 1, Day 8, and Day 90 was added to the study schedule of events to inform interpretation of the results of female reproductive hormone assessments.
- A telephone-based contact 6 months after treatment of each attack was added to document pubertal changes/milestones, if any.
- Documentation of HAE attacks not treated with icatibant was added to the schedule of events on Day 90.

2. Detailed Summary of Changes for the Amendment

This is a section that has been updated to describe the changes from the previous protocol version. Significant changes and additions to the protocol text are captured below.

Changes in grammar, spelling, punctuation, format, minor editorial changes (including re-ordering of text or other edits for consistency and clarity), and updates to the list of abbreviations and cross-references are not reflected in the change summary.

Bold text indicates new text. ~~Strikethrough~~ text indicates deleted text.

CHANGES TO TEXT

Change: Addition of a new medical monitor
Section impacted by change: Cover page
Change: PPD [REDACTED] MD, PhD Shire Human Genetic Therapies (HGT), Inc. Mobile: PPD [REDACTED]
Other sections impacted by change: 7.17.4.2 Reporting Serious Adverse Events

Change: Clarification concerning onset of symptoms
Section impacted by change: 1.1 Disease Background
Although acute episodes of HAE may occur at any age, the mean median age at first symptomatic HAE attack is estimated to range between 4 to 11 years (reviewed by Farkas⁶). Subcutaneous edema of the extremities, face, neck, torso, and genitals is the most common, and usually the earliest, manifestation of HAE seen in children. Two peaks of increased frequency and severity of HAE symptoms were reported in a large pediatric cohort, one peak between 3 and 6 years of age and the second at around puberty. These peaks are attributed to physiological changes which occur in these periods of development.⁶
Other sections impacted by change: None

Change: Clarification concerning HAE management
Section impacted by change: 1.1 Disease Background
Prompt control of attacks, short-term prophylaxis, "intermittent" prophylaxis, long-term prophylaxis and emergency therapy are recommended for the management of pediatric HAE. ⁶ Treatment options for children with HAE according to current guidelines include antifibrinolytics, attenuated androgens, and C1 inhibitor (C1-INH) replacement therapy. Current guidelines favor antifibrinolytics for long term prophylaxis because of their safety profile relative to attenuated androgens. The preferred antifibrolytic agent, where approved for use, is tranexamic acid, though ε-aminocaproic acid is sometimes also used for this purpose.
Other sections impacted by change: None

Change: Clarification concerning pubertal status assessment
Section impacted by change: 4.1.1 Study Design
A subject's classification as prepubertal or pubertal/postpubertal will be determined at the time of the first icatibant-treated HAE attack. Subjects classified as pubertal/postpubertal at screening will not require further evaluation of pubertal status during the study, whereas subjects classified as prepubertal at screening will have their pubertal status reassessed at the time of their first icatibant-treated HAE attack visit.

Y	Y	Y Y	nY	IY	Y Study Schedule of Events (Initial Icatibant-
Y	HY	Y	Y Study Schedule of Events (Subsequent Icatibant-treated Attacks)		

nY	Y	Y	Y Y	Y Y	Y Y
Section impa	Y Y	nY-r-r	Study Design		
Change: Initially, enrollment and dosing of pubertal/postpubertal subjects will precede that of prepubertal subjects. After the first 4 subjects in the pubertal/postpubertal group have been treated, icatibant PK, safety, tolerability, and efficacy data will be reviewed by an independent Data and Safety Monitoring Board (DSMB). The DSMB review of the first 4 subjects shall be completed prior to continuing enrollment of additional pubertal/postpubertal subjects, icatibant treatment of second and third HAE attacks in pubertal/postpubertal subjects, and initiating enrollment of subjects in the prepubertal group.					
Y	Y	Y Y	nY		

Change: Clarification concerning duration of time for monitoring and assessment					
Y	Y Y	nY-r-r	Study Design		
Change: Subjects will be monitored closely in the hospital/study center for at least 6 to 8 8 hours after treatment. A subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score must be zero, denoting the absence of symptoms). If HAE symptoms have not completely resolved at 6 hours (ie, the investigator-rated symptom score is >0), the subject shall remain in the hospital/study center for at least 8 hours after icatibant administration .					
Y	Y	Y Y	nY		

Change: Clarification concerning subject participation					
Y	Y Y	nY-r-r	Study Design		
Change: Subjects who reach their 18th birthday during the course of follow-up are allowed to remain in the study and receive subsequent treatments with icatibant according to the protocol.					
Other sections impacted by change: None					

Change: Addition of telephone follow-up every 6 months					
Y	Y Y	nY-r-r	Study Design		
Change: The investigator will schedule a telephone contact approximately 6 months after Day 1 of each icatibant-treated attack to obtain specific updates concerning pubertal changes/milestones.					
Y	Y	Y Y	nY	IY-r-y	Study Assessments C Y (der)

Change: Allowance for a window for performance of assessments schedules on Day 8					
Y	Y Y	nY-r-y	Study Assessments		
Change: Post-treatment Day 1 through Day 8 (± 1 day)					
Y	Y	Y Y	nY	IY-r-y	Y Y (der)

Change: Clarification concerning timing of treatment of subsequent attacks				
Y	Y	Y	nY	r-y Study Assessments
Change: In the event that a subsequent attack occurs at least 7 days after prior treatment, but within the window (±1 day) allowed for performance of Day 8 assessments associated with a prior attack, the Day 8 assessments may also serve as the pretreatment (baseline) assessments for the subsequent attack.				
Other sections		Y	Y	nY

Change: Detail concerning 6e				
Y	Y	Y	nY	r-y Study Assessments
Change: The investigator will schedule a telephone contact approximately 6 months after Day 1 of each icatibant-treated attack to obtain updates concerning pubertal changes/milestones. If this prescheduled telephone contact date should occur within the 90-day follow-up period (ie, Day 1 through Day 90) of a subsequent attack, this prescheduled contact may be omitted.				
Y	Y	Y	Y	nY IY der Study Periods

Change: Clarification concerning duration of subject participation				
Y	Y	Y	nY	p Study Duration
Change: Once eligibility is established at screening, the subject will be enrolled but will enter a period of inactive participation of variable duration until such time as the subject experiences an acute attack of HAE and is offered treatment. At that time, the subject will enter a 90-day period of active participation which will consist of treatment with a single SC administration of icatibant on Day 1 through follow-up at Day 90. After receiving treatment for an initial attack of acute HAE, at least 15 pubertal/postpubertal subjects who present with subsequent attacks of acute HAE will continue to receive treatment with icatibant for a total of 3 attacks each. Thus, the period of active participation in the study for prepubertal subjects will be approximately 90 days, while that for pubertal/postpubertal subjects will be a maximum of approximately 270 days (3 separate active of approximately 90 days), with each active period separated by periods of inactive participation of variable duration. The period of active participation may be shorter if pubertal/postpubertal subjects have recurrent HAE attacks in between the Day 8 and Day 90 visits for a prior icatibant treated HAE attack. Telephone follow-up will occur approximately 6 months after each icatibant-treated attack. Once the sixteenth prepubertal subject and the twentieth pubertal/postpubertal subject have completed the Day 90 6-month follow-up after treatment for an initial attack, and the fifteenth pubertal/postpubertal subject has completed the Day 90 6-month follow-up after his or her third and final treatment, the study will be closed.				
Other sections impacted by		nY		

nY	Y	Study population		
Y	Y	Y	nY	r Study Population
Change: The study will enroll a sufficient number of children and adolescents to ensure study completion of 36 evaluable subjects. The study population will consist of subjects from 2 through 17 years of age who present with an acute cutaneous, abdominal, or laryngeal HAE attack, at least 16 of whom were prepubertal at the time of their first icatibant treated HAE attack and 20 of whom were pubertal/postpubertal at the tim				
Y	Y	Y	Y	nY

Change: Clarifications to inclusion criteria				
Y	Y	Y	NY -y	Inclusion criteria
Change:				
1. Two through 17 years of age, inclusive (ie, from the second birthday until the day prior to the eighteenth birthday) at the time of the subject's first HAE attack treated with icatibant as part of this study.				
2. Documented diagnosis of HAE type I or II. Diagnosis must be confirmed by documented immunogenic (below the lower limit of normal) and/or functional (<50% of normal levels) C1-INH deficiency (C1-INH protein level below the lower limit of normal and/or functional level <50% of normal). Diagnosis may be on the basis of historic data or by diagnostic testing conducted at the time of screening. Inclusion will be permitted initially based on medical history only if a clear diagnosis has been made based on all of the following criteria:				
<ul style="list-style-type: none"> - Family history - Characteristic attack manifestations, recurrent attacks - Historical C1-INH deficiency as demonstrated by immunologic or functional test results - Exclusion of other forms of angioedema - Subsequent confirmation of the diagnosis to be made on the basis of C1-INH level or function (all subjects) 				
Y	Y	Y	Y	NY

Change: Clarifications to exclusion criteria				
Y	Y	Y	NY -y	Inclusion criteria
Change:				
2. Participation in another clinical study during the 30 days prior to treatment trial that involves use of any investigational product (drug or device) within 30 days prior to study enrollment or at any time during the study.				
9.				
Other sections impacted by NY				

NY	Y	Y	Y	Y
Y	Y	Y	NY -y	Treatments Administered
Change:				
All subjects will receive treatment with icatibant for an initial acute attack of HAE as a single, weight-adjusted dose of 0.4 mg/kg up to a maximum of 30 mg administered in the abdominal region as a SC injection.				
Y	Y	Y	Y	NY IY-r-y Study Assessments

NY	Y	Y	Y	Y
Section impacted by change: h-h Concomitant Medication Usage				
Change:				
Use of the following concomitant medications is forbidden within 90 days prior to treatment, and for 90 days after receiving treatment with icatibant:				
Other sections impacted by change: None				

Change: Clarification to rescue medications				
Section impacted by change: h-v Rescue Therapy				

Change:

Rescue therapies will include agents to control the HAE attack, such as C1-INH inhibitor concentrates. C1-INH therapy has been used safely for the treatment of acute attacks in the pediatric setting.⁶ If C1-INH concentrates are unavailable, FFP may be used.⁷ A kallikrein inhibitor, ecallantide, approved only in the United States, is indicated for use in patients 16 years of age and older.

Other acceptable rescue therapies for acute attacks include palliative medications that are intended to ameliorate the symptoms (eg, pain, nausea) of angioedema rather than to control the HAE attack itself. If pain medication is required, the investigator may administer intravenous or prescription-strength non-steroidal anti-inflammatory drugs (NSAIDs) for mild to moderate pain and administer morphine sulfate (or opiate equivalent) intravenously or intramuscularly at a dose of 0.05 mg/kg (or an equivalent dose if another opiate medication is used). Antiemetics may also be prescribed as necessary to treat nausea. Acceptable rescue therapies may also include epinephrine, intravenous fluids, or other medicinal products at the discretion of the investigator.

Other sections impacted by change: None

Change:

Y Y Y Y

Y Y Y ~~n~~ Menstrual Cycle History

Change:

7.6 Menstrual Cycle History

A menstrual cycle history will be determined historically for female subjects and will be recorded in the CRF. The timing of the blood sampling with respect to the menstrual cycle must be known to inform the interpretation of any potential changes in reproductive hormones in adolescent females, because of the normal cyclical rise and fall of reproductive hormones of the menstrual cycle.

Instructions for investigators:

To assist in this determination, investigators should obtain the following information and document in the CRF.

- Age of menarche.
- Normal duration of menstrual flow.
- Normal interval in between menstrual periods.
- Date of last onset of bleeding.
- Prospectively ask female subjects to write down subsequent dates of onset of bleeding and cessation of bleeding between Day 1 and Day 90.
- Date of ovulation (sometimes called ovulation pain, mid-cycle pain or mittelschmerz) may also be documented if subjects can identify this feeling.

Y Y Y Y ~~n~~

Change: Clarification to PK sampling times

Y Y Y ~~n~~ Pharmacokinetic Sampling

Change:

Blood samples for determination of plasma concentrations of icatibant in pubertal/postpubertal subjects will be collected on Day 1 at pretreatment, and at 15 (±5) minutes, 30 (±5) minutes, 45 (±5) minutes, 1 hour (±10) minutes, 2 hours (±10) minutes, 4 (±0.5) hours, and 6 (±0.5) and 8 (±0.5) after treatment.

Blood samples for determination of plasma concentrations of icatibant in prepubertal subjects will be collected on Day 1 at pretreatment, and at 15 (±5) minutes, 30 (±5) minutes, 2 hours (±10) minutes, 4 (±0.5) hours, and 6 (±0.5) hours and 8 (±0.5) after treatment.

Y Y Y Y ~~n~~ IY Y Study Schedule of Events (Initial Icatibant-treated Attack)

Change: Investigator assessment of pain in children younger than 4 years of age
Section impacted by change: v-r-r-p Investigator Assessment of Pain
Change: Subjects who are below 4 years of age will undergo investigator assessment of HAE-related pain (cutaneous, abdominal, and laryngeal) using the Faces, Legs, Activity, Cry, and Consolability (FLACC) comportmental pain scale.
Other sections impacted by change: Synopsis , y-y Secondary Endpoints

Change: Clarification to evaluation of injection site reactions
Section impacted by change: w-r-p-x Local Tolerability
Change: Injection site reactions (erythema, swelling, burning sensation, itching/pruritis, warm sensation, cutaneous pain, or other) will be evaluated by the investigator or other medically qualified personnel when the subject is at the hospital/study center, and the diameter of any erythema or swelling will be measured.
Other sections impacted by change: None

Change: Clarification to pregnancy testing
Section impacted by c w-r-p-v Pregnancy Testing
Change: Female subjects of childbearing potential (ie, those who have experienced menarche) will undergo pregnancy testing at time points specified in the study schedule of events in Appendix 1 and Appendix 2. All pregnancy testing will be conducted using a urine human chorionic gonadotropin (hCG) test kit. The test will be performed and interpreted by the study personnel at the hospital/study center at the time of the visit.
Other sections impacted by change: None

Change: Clarification concerning blood sample collection
Y Y Y w-r-d Sample Collection, Storage, and Shipping
Change: Use of an indwelling catheter is encouraged for collection of serial blood samples for PK assessments when feasible. Use of a topical local anesthetic (such as EMLA or LMX) is acceptable to make the procedure more tolerable for children, provided that the timing of this application does not interfere with blood sample collection. Subjects will be in a seated or supine position during blood collection.
Other sections impacted by change: None

Change: Clarification to adverse event recording
Y Y Y w-r-h Recording of Adverse Events
Change: 7.16 Recording of Adverse Events Adverse events will be collected over an observation period from the time of treatment until the follow-up visit 90 (±7) days after investigational product administration (or until the event has resolved/stabilized or an outcome is reached, whichever comes first). Adverse event monitoring and the period of observation defined for this study are described in Section 7.17.4.1.
Other sections impacted by change: v-r-v-d-r Adverse Event Monitoring and Period of Observation

Change: Clarification to adverse event definition
Section impacted by change: v-r-v-r-r Adverse Event
Change:

Any exacerbation or worsening of symptoms of an acute HAE attack treated with icatibant is considered a result of the underlying disease and will not be considered an adverse event (unless meeting the criteria for a serious adverse event, see Section 7.17.1.2) ...

The treated HAE attack is defined as any symptoms occurring in treated subjects within 48 hours of the onset of symptoms. Clinically relevant worsening of the signs and symptoms of a treated attack is considered to be related to the underlying disease of HAE and will be collected **in the appropriate CRF** separately from general reports of adverse events **unless meeting the criteria of a serious adverse event**. Symptoms reoccurring more than 48 hours after an initial attack will be considered a new attack, and will also not be reported as adverse events. **Attacks not treated with icatibant will be documented in the appropriate CRF at the Day 90 visit;** they are considered to be pre existing disease and will not be documented as adverse events.

Other sections impacted by change: None

Change: Clarification to adverse event severity classification

Section impacted by change: 7.17.2 Classification of Adverse Events and Serious Adverse Events

Change:

The severity of adverse events will be assessed by the investigator as mild, moderate, or severe based on the scale in Table 7-2. The severity of adverse events and serious adverse events should be recorded on the appropriate CRF page as Grade 1, 2, or 3, corresponding, respectively, to a severity of mild, moderate, or severe.

Table 7-2 Adverse Event Severity

Grade	Severity	Definition
Grade 1	Mild	No limitation of usual activities.
Grade 2	Moderate	Some limitation of usual activities.
Grade 3	Severe	Inability to carry out usual activities.

Other sections impacted by change: None

Change: Clarification concerning adverse event collection

Section impacted by change: 7.17.4.1 Adverse Event Monitoring and Period of Observation

Change:

Adverse events will be monitored continuously. For the purposes of this study, the safety observation period will extend from the time of treatment of the subject's acute HAE attack until the subject's final evaluation after treatment. For subjects who complete the study, the final evaluation of adverse events will occur at the follow-up visit performed 90 (±7) days after treatment with investigational product..

Other sections impacted by change: 7.16 Recording of Adverse Events

Change: Addition of new medical monitor contact information

Section impacted by change: 7.17.4.2 Reporting Serious Adverse Events

Change:

Shire Pharmacovigilance and Risk Management Department:
 FAX: PPD (Worldwide) OR PPD (North America)
 Email: PPD
 AND
 Shire HGT Medical Monitor: PPD MD, PhD
 PPD
 FAX: PPD (USA)

If an SAE is assessed as severe and unexpected, or life-threatening, contact:
PPD [REDACTED] MD, PhD PPD [REDACTED] Shire Human Genetic Therapies, Inc. 300 Shire Way Lexington, MA 02421 USA Telephone: PPD [REDACTED] Mobile: PPD [REDACTED] Fax: PPD [REDACTED] (USA) PPD [REDACTED]
Other sections impacted by change: Cover page

Change: Clarification concerning monitoring of pregnancy
Section impacted by change: 7.18 Pregnancy
Change: The sponsor must be notified in the event of a pregnancy occurring during the course of the study and through 90 180 days after the subject's last dose of investigational product.
Other sections impacted by change: None

Change: Clarification concerning FLACC scale
Section impacted by change: 7.19 Appropriateness of Measurements
Change: The FLACC instrument comprises 5 categories of behavior (face, legs, activity, cry, consolability) to assess pain in young preverbal children and children with limited verbal capability . ^{12, 13}
Other sections impacted by change: Appendix 5 Faces, Legs, Activity, Cry, and Consolability Scale (FLACC)

Change: Clarifications to study activities
Section impacted by change: 8 Study Activities
Change:
8.1 Screening (Day of Informed Consent to Pretreatment on Day 1 of the Initial Attack)
<ul style="list-style-type: none"> • Pubertal status determination • Urine pregnancy test (in females of childbearing potential)
8.2 Pretreatment (Baseline) Assessments (Day 1, Initial and Subsequent Attacks)
<ul style="list-style-type: none"> • Confirm inclusion/exclusion criteria (at initial attack only) • Tanner staging Pubertal status determination (only if the subject was classified as prepubertal at the time of the screening visit) • Menstrual cycle history (in pubertal/postpubertal females only) • Urine pregnancy test (in females of childbearing potential)
8.3 Initial Attack
8.3.1 Treatment Period (Day 1 to Day 8 [\pm 1 Day])
<ul style="list-style-type: none"> • Sampling for PK assessments in pubertal/post pubertal subjects (Day 1, 15 minutes (\pm5 min), 30 minutes (\pm5 min), 45 minutes (\pm5 min), 1 hour (\pm 10 minutes), 2 hours (\pm10 minutes), 4 (\pm0.5) hours, 6 (\pm0.5) hours post dose at initial attack only)) • Sampling for PK assessments in prepubertal subjects (Day 1, 15 (\pm 5) minutes, 30 (\pm 5) minutes, 2 hours (\pm10 minutes), 4 (\pm0.5) hours, 6 (\pm0.5) hours post dose at initial attack only)) • Clinical laboratory tests (Day 1, & 6 (\pm0.5) hours post dose and Day 8 (\pm1 day)) • Reproductive hormone assessments (Day 1, & 6 (\pm0.5) hours post dose and Day 8 (\pm1 day))

- Safety follow-up contact (Day 2 (24 (±4) hours), Day 3 (48 (±4) hours)) either by telephone or in person at the investigator's discretion
- Menstrual cycle history (Day 8 (± 1 day)) (in pubertal/postpubertal females)

It is indicated in the list of study activities that the windows allowed for collection of PK samples should also be applied to collection of other assessments being performed at those time points. It is further stated that a subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score = zero, denoting the absence of symptoms). If this is the case, the assessments (*) scheduled for 8 hours post treatment will be omitted with the exception of subject self-assessment of HAE-related pain using the e-diary FPS-R. If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated (***) will be performed at both 6 AND 8 hours post treatment.

If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated (***) will be performed at either 6 OR 8 hours post treatment.

8.3.2 Follow-up Visit (Day 90 ±7 days)

- ~~Tanner staging (for those subjects classified as Tanner stage IV or below at baseline)~~
- Urine pregnancy test (in females of childbearing potential)
- Menstrual cycle history (in pubertal/postpubertal females)
- Documentation of HAE attack(s) not treated with icatibant

8.3.3 Telephone Contact (Month 6 ±7 days) .

The scheduled telephone contact will document pubertal changes/milestones, if any.

- Pubarche
- Menarche (females only)
- Changes in menstrual cycle (females only)
- Pregnancy (females and male partner)

8.4 Subsequent Attacks (Pubertal/postpubertal Subjects Only)

8.4.1 Treatment Period (Day 1 to Day 8 [±1 day])

- Clinical laboratory tests (Day 1, & 6 (±0.5) hours post dose and Day 8 (±1 day))
- Reproductive hormone assessments (Day 1, & 6 (±0.5) hours post dose and Day 8 (±1 day))
- Safety follow-up contact (Day 2 (24 (±4) hours), Day 3 (48 (±4) hours)) either by telephone or in person at the investigator's discretion
- Menstrual cycle history (Day 8 (± 1 day)) (in pubertal/postpubertal females)

It is indicated in the list of study activities that the windows allowed for collection of PK samples should also be applied to collection of other assessments being performed at those time points. It is further stated that a subject may be discharged after completion of all assessments at 6 hours post treatment, if deemed medically stable in the investigator's clinical judgment and the subject's HAE symptoms have resolved (the subject's investigator-rated symptom score = zero, denoting the absence of symptoms). If this is the case, the assessments (*) scheduled for 8 hours post treatment will be omitted with the exception of subject self-assessment of HAE-related pain using the e-diary FPS-R. If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated (***) will be performed at both 6 AND 8 hours post treatment.

If the subject's HAE symptoms have not resolved at 6 hours post treatment (the subject's investigator-rated symptom score ≠ zero) and the subject is not to be discharged after completion of assessments at the 6-hour time point, the assessments indicated (***) will be performed at either 6 OR 8 hours post treatment.

<p>8.4.2 Follow-up Visit (Day 90 ±7 days)</p> <ul style="list-style-type: none"> • Tanner staging (for those subjects classified as Tanner stage IV or below at baseline) • Urine pregnancy test (in females of childbearing potential) • Menstrual cycle history (in pubertal/postpubertal females) • Documentation of HAE attack(s) not treated with icatibant <p>8.4.3 Telephone Contact (Month 6 ±7 days)</p> <p>The scheduled telephone contact will document pubertal changes/milestones, if any.</p> <ul style="list-style-type: none"> • Pubarche • Menarche (females only) • Changes in menstrual cycle (females only) • Pregnancy (females and male partner)
<p>Y Y Y Y nY r-y Y Y IY Y Study Schedule of Events (Initial Icatibant-treated Attack), Y Study Schedule of Events (Subsequent Icatibant-treated Attacks)</p>

Change: Clarification Y Y
Y Y Y nY f-v Efficacy Analysis
Change: The investigator will report symptom scores at pretreatment and 1, 2, 4, and 6 hours and 8 hours post treatment, and at 8 hours post treatment for subjects who had not shown complete resolution of HAE symptoms at 6 hours.
Other sections impacted by change: None

nY Y Y Y
Section impacted by change: r f-w Data Monitoring and Interim Analysis
Change: An analysis of the data for DSMB review is planned after the first 4 subjects in the pubertal/postpubertal group have been treated, and is planned to follow quarterly enrollment milestones (ie, 25%, 50%, and 75%) thereafter.
Other sections impacted by change: None

nY Y Y Y
Section Y Y Y nY r-v-r Critical Documents
Change: • Curricula vitae of investigator and sub-investigator(s) (current, dated and signed within 12 24 months of study initiation).
Other sections impacted by change: None

Change: Clarification concerning waivers
Section impacted by change: r r-w Protocol Violations/Deviations
Change: A record of subjects screened, but not entered into the study, is also to be maintained. For any subject who does not meet the inclusion or exclusion criteria a protocol exemption may be requested by the investigator. This exemption may be approved by the Shire HGT Medical Monitor prior to enrollment and the protocol exception must be fully documented in the source documents and on the appropriate page of the CRF. No protocol waivers or exemptions will be considered by the sponsor during the study.
Other sections impacted by change: None

Change: Clarification to female pubic hair stage
Section impacted by change: Appendix 3 Modified Sexual Maturation Scale
Change: Sparse growth of long, slightly pigmented downy hair, straight or only slightly curled, appearing chiefly along the labia on the pubis. Do not consider hair on the labia. a Pubic hair development reflects adrenal function, not hypothalamic/gonadal function. The descriptions used in this table are intended to provide guidance for the investigators and may not align with descriptions of pubic hair and pubertal stage in other sources.
Other sections impacted by change: None