A single-center study on the efficacy and safety of Artificial Intelligence-assisted navigation system for pancreatic endoscopic ultrasonography

Short Title：Endoangel Study

NCT	-
Trial number	EA-19-003
Protocol version	1.1
Version date	Dec 12, 2019
Country	China
Device	EndoAngel™
Principal investigator	Professor HonggangYu
Address	No. 99, Zhangzhidong Road, Wuchang District, Wuhan, Hubei.

Content

1. Summary

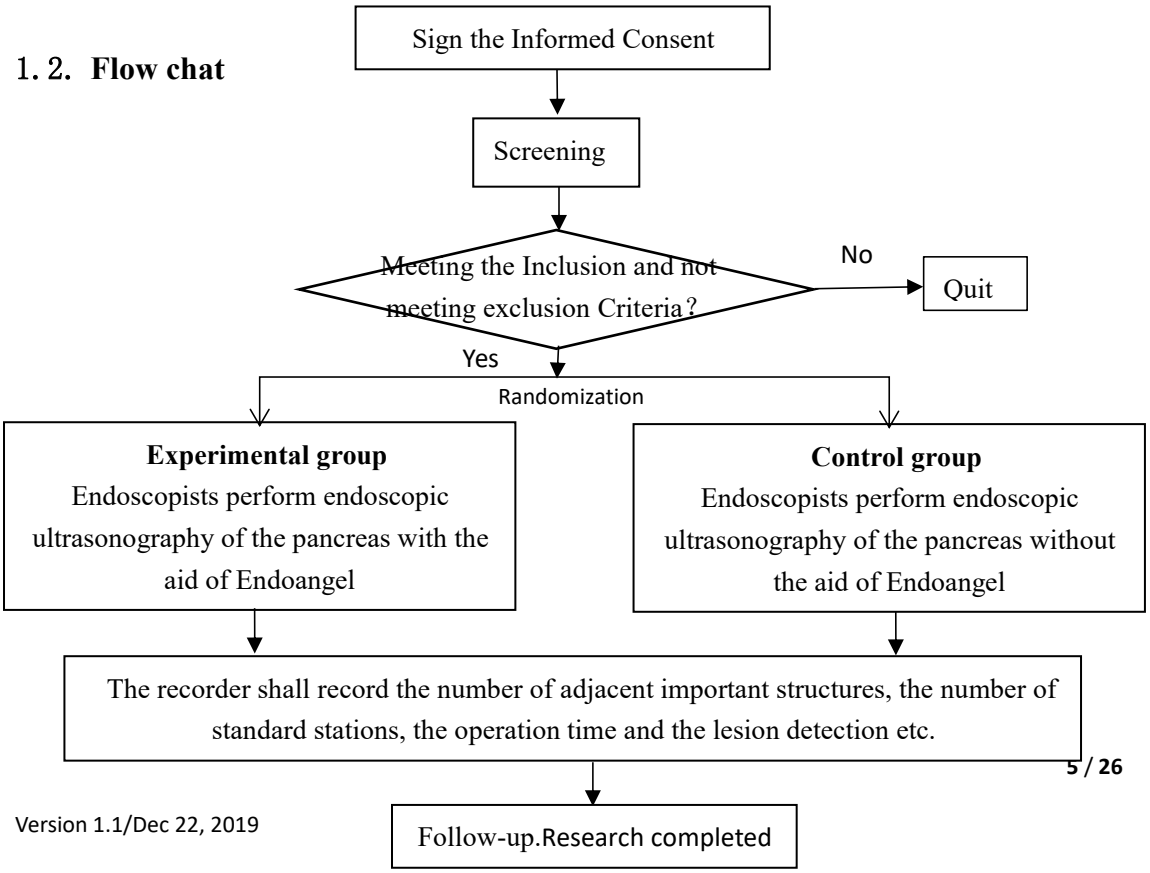
Title:	A single-center study on the efficacy and safety of Artificial Intelligence-assisted navigation system for pancreatic endoscopic ultrasonography
Short Title:	*EndoAngel Study*
Trial number:	EA-19-003
Research system	EndoAngel
Expected effect:	ENDOANGEL's intended use is to effectively improve the quality of EUS scanning for physicians, enhance the cognitive ability of endoscopists in endoscopic ultrasound images, and reduce the missed diagnosis of lesions.
Primary Endpoint:	Missed scanning rate of adjacent important anatomical structures in pancreatic endoscopic ultrasonography
Secondary Endpoints:	1.Pancreatic lesions detection rate; 2.Cholangiopancreatic duct lesions detection rate 3.The average number of scanning in the pancreatic standard station of endoscopic ultrasonography 4.Detection rate of lesions in different pancreatic standard stations of endoscopic ultrasonography 5.Missed scanning rate of adjacent vital anatomical structures in different pancreatic standard stations of endoscopic ultrasonography 6.Mean scanning time in different pancreatic standard stations of endoscopic ultrasonography
Trail design:	Prospective, single-center, randomized controlled trial
Participants:	Male and female subjects aged 18 years or older will require a endoscopic ultrasonography, and voluntarily provide endoscopic ultrasonography imaging data and sign an informed consent form.
Sample size:	285 samples needed to be enrolled
Study Process:	Subjects who met all inclusion criteria and did not meet all exclusion criteria were included in the study before endoscopic ultrasonography. All included subjects signed an informed consent form. Subjects will be randomized prior to the start of the examination to either an Endoangel-assisted experimental group or a control group without Endoangel assistance. The operating physician completed the endoscopic ultrasonography according to the presence or absence of AI prompt. The recorder shall record the number of adjacent important structures, the number of standard stations, the operation time and the lesion detection etc. Follow-up will be performed for one week after the end of examination. The end time of follow-up is the end time of study. And the results are sent to an independent data analysis team for review.

Security	Safety incidents shall be evaluated and reported according to the quality management measures for clinical trials of medical devices

1.1. Time and Event Tables

Events	Screening period （d -30~-1）	The day of EUS（d 0）	Follow up (d 1-14)
Informed Consent	X		
Basic characteristics	X		
Medical history/surgical history	X		
Inclusion/Exclusion Criteria	X		
Random		X	
Endoscopic Ultrasonography		X	
Concomitant treatment	X	X	
Concomitant medication	X	X	
Adverse Events		X	X
Research completed			X

1. 2. Flow chat



2. Introduction

Pancreatic cancer is a malignant tumor of the digestive system with insidious onset, rapid progression and very poor prognosis[1, 2]. According to the latest cancer data in China in 2020 released by the International Agency for Research on Cancer (IARC) of the World Health Organization, there are about 120,000 new cases of pancreatic cancer in China, with a mortality rate close to 100%, which seriously endangers the national health[3, 4]. Early diagnosis of pancreatic cancer can be achieved by surgical resection with a 5-year survival rate of 58% [5], Once advanced pancreatic cancer develops, patient survival is 7.2%[6]. As a rapidly developing deadly cancer, missed diagnosis of pancreatic cancer may have extremely serious consequences for patients.How to improve the diagnostic rate of early pancreatic cancer is an urgent problem to be solved.

EUS(endoscopic ultrasonography) is considered one of the most sensitive modalities for pancreatic cancer detection. It has a much higher diagnostic accuracy than MRI and CT for the diagnosis of pancreatic cancer, especially early pancreatic cancer < 1 cm in diameter (EUS-FNA 95.6% vs CT 77.4%, MRI 76.2%)[7-9]. EUS is the modality of choice for the early diagnosis of pancreatic tumors[10]. To avoid a missed diagnosis of the pancreatic cancer, the continuity and integrity of EUS needs to be ensured as much as possible. But EUS is highly operator-dependent and the learning curve is steep, and the quality of the examination is highly dependent on the operator's technique[11-13]. Therefore, it is necessary to develop a system that can effectively assist the full scanning of EUS.

The station approach in pancreatic EUS has been established as the standard scanning procedure[14-15]. The principle of completing the station approach is to find the anatomical landmarks of this station[16-17], Such as organs (kidney, spleen), blood vessels (such as splenic artery, splenic vein, portal vein), ducts (pancreatic duct, bile duct), etc.The scanning of these anatomical landmarks is the basis for an accurate assessment of the entire pancreas。

At the same time, the type of pancreatic lesions and the development of the course have abnormal imaging findings of different anatomical structures[18-19]. For example, ultrasound images of pancreatic cancer will show vascular invasion, deformation of the biliopancreatic duct, and metastasis of adjacent organs[20]. The guidelines clearly require that the choice of surgical approach for pancreatic cancer needs to be based on the degree of invasion of the cancer to adjacent important anatomical structures, to maximize the volume sparing of functional pancreatic parenchyma[21]. Complete anatomical scanning can assist in the diagnosis of pancreatic lesions and guide patient treatment and prognosis.

In recent years, artificial intelligence (AI) has been successfully applied in multiple medical fields[22-24]. At present, there have been studies of AI-based endoscopic ultrasonography for the identification of pancreatic lesions[25-27], However, there are no studies of AI-based navigation system for pancreatic endoscopic ultrasonography. Previously, we have successfully developed a standard station scanning navigation system for the pancreas and bile ducts. This system can improve the recognition accuracy of endoscopists for standard stations and enhance the cognitive ability of endoscopic ultrasonography images[28-29].

Based on the previous, we constructed a deep learning-based pancreatic scanning navigation system in EUS, which can assist in identifying important anatomical structures adjacent to the pancreas in real time. and verify its auxiliary performance for endoscopists in clinical practice. In order to improve the quality of EUS and reduce the missed diagnosis of pancreatic lesions.

3. Patient Selection

Male and female subjects aged 18 years or older will require a endoscopic ultrasonography, and voluntarily provide endoscopic ultrasonography imaging data and sign an informed consent form.

Patients not meeting the inclusion criteria or meeting exclusion criteria will not be considered for participation in the study. Patients who met all criteria and singed informed consent may be excluded from the study due to:

• Endoscopists' professional advices/medical reasons (only under very limited conditions to avoid researcher bias).

• Withdraw informed consent.

3.1. Inclusion criteria

All patients meeting the following criteria will be considered for participation in the study:

1) Male or female aged 18 or above;
2) EUS is needed to further clarify the characteristics of digestive tract diseases;
3) Patients able to give informed consent were eligible to participate.
4) Able and willing to comply with all study process.

3.2. Exclusion criteria

All patients meeting the following criteria will not be considered for participation in the study:

1) Has participated in other clinical trials, signed informed consent and was in the follow-up period of other clinical trials.
2) Has participated in clinical trials of the drug and is in the elution period of the experimental drug or control drug.
3) Drug or alcohol abuse or psychological disorder in the last 5 years.
4) Patients in pregnancy or lactation.
5) A history of Upper Gastrointestinal surgery.
6) Patients with anatomical abnormalities of the upper gastrointestinal tract due to advanced neoplasia
7) Patients in whom the presence of clearly defined vital anatomical structures cannot be observed
8) Researchers believe that the patient is not suitable to participate in the trial.

3.3. Definition of enrollment

After participants signed informed consent, they were randomized before the endoscopic ultrasonography. The randomization time was the enrollment time, and was recorded in CRF.

4. Endpoints

4.1. Primary Endpoint

1) Missed scanning rate of adjacent important anatomical structures in pancreatic endoscopic ultrasonography：
It was calculated by dividing the number of important anatomy that is not scanned in the actual EUS pancreas by the number of EUS.

4.2. Secondary Endpoints

1) Pancreatic lesions detection rate: It was calculated by dividing the total number of patients being detected pancreatic lesions by the number of EUS.
2) Cholangiopancreatic duct lesions detection rate: It was calculated by dividing the total number of patients being detected cholangiopancreatic duct lesions by the number of EUS.
3) The average number of scanning in the pancreatic standard station of endoscopic ultrasonography: It was calculated by dividing the total number of scanning in the pancreatic standard station by the number of EUS.
4) Detection rate of lesions in different pancreatic standard stations of endoscopic ultrasonography: It was calculated by dividing the number of patients with pancreatic lesions and Cholangiopancreatic duct lesions in the different standard stations by the number of EUS.
5) Missed scanning rate of adjacent vital anatomical structures in different pancreatic standard stations of endoscopic ultrasonography: It was calculated by dividing the number of important anatomy that is not scanned in the different standard stations by the number of EUS.
6) Mean scanning time in different pancreatic standard stations of endoscopic ultrasonography: It was calculated by dividing the total scanning time by the number of EUS.

4.3. Safety evaluation endpoints and other secondary endpoints

Adverse events shall be determined according to the definition in the code for the quality management of adverse events of medical devices. The following types of adverse events should be recorded and calculated in the hospital history and CRF. According to the CRF table, the

occurrence time, starting and ending time, intervention measures and treatment results should be filled in when recording. The severity should be referred to the previous literature and CTCAE 5.0 standard.

5. Purpose and overall design

5.1. Purpose

The purpose of this study is to develope the Endoangel with real-time pancreatic scanning navigation system in EUS. It can assist in identifying important anatomical structures adjacent to the pancreas in real time. and verify its auxiliary performance for endoscopists in clinical practice. In order to improve the quality of EUS and reduce the missed diagnosis of pancreatic lesions.

5.2. Overall design

This is a prospective, single-center, randomized controlled trial study.

6. Study process

6.1. Summary of Study Process

• If the patient meets the inclusion criteria, the patient is invited to participate in the study and then the informed consent procedure for the clinical trial is applied.
• Assess patients' eligibility based on the inclusion/exclusion criteria.
• If the patient meets the inclusion/exclusion criteria, information prior to EUS will be collected
• If the patient is enrolled, he will be randomized
• EUS is performed after informed consent. Any intraoperative adverse events are recorded on the CRF for submission and subsequent analysis.
• Follow-up will be performed from the postoperative to the study completion, as detailed in the time and event table.

6.2. Enrollment

Only after patients signed the informed consent, can the research-related procedures be conducted.

6.2.1. Informed Consent

According to the Helsinki Declaration, patients are not allowed to participate in the study without adequate informed consent. The principal investigator is responsible for ensuring that no patient was enrolled in the study without adequate informed consent. Failure to obtain informed consent and failure to document this process is considered a violation of the Helsinki Declaration and the study protocol.

All informed consent documents (ICDs) must be approved by ethics. Patient's informed consent requires documentary record on the informed consent by himself in his primary language.

The investigator or trained designated person performs a preliminary screening to determine if the patient generally meets the eligibility criteria for the study. If yes, the investigator or trained designee should recommend the patient to participate in the study. If the patient agrees to participate, they will need to sign an informed consent document.

The investigator or trained designated person should confirm that the subject understands the following points in the study:

• the purpose of research,
• potential risks or adverse events,
• Potential risks or adverse events directly related to participating the research,
• The likelihood of failure,
• Research requirements include follow-up visits,
• All rights of the subject as a participant in the clinical study.

After explaining the purpose of the study, the investigator or trained designee should answer any questions from the subject. If the subject agrees to participate, his or her wishes must be recorded by signing and dated on the EC-approved ICF, and the document should be signed and dated by the patient receiving the informed consent.

After successful completion of the informed consent process, the investigator or trained designated person will assess the eligibility of patients based on the protocol.

6.2.2. Patient Selection

All patients who underwent EUS, agreed to use EndoAngel and generally meet the study requirements were screened based on the inclusion/exclusion criteria. Patients who passed the screening were enrolled and recorded in the subject screening and enrollment tables. There is no bias in the choice of the enrolled subjects. The date of screening, the results (enrolled or not), and the primary reason for not selecting subjects (such as not meeting inclusion criteria, or not interested in participating in the study) will be recorded.

After the patients are enrolled, the research center should complete the preoperative study data collection.

It is desirable to be able to collect complete data for all enrolled patients, without those withdrawal from the study.

6.2.3 Subject identification number

Patients were numbered after signing informed consent.

The subject number begins with EA as a fixed number and is numbered starting from 0001 at the time of signing the informed consent. For example, the first patient who signed the informed consent was EA0001, and the second one was EA0002.

Once the subject identification number is assigned, the number is not reusable.

6.3 Treatment Description

This section applies to individuals who have signed an approved informed consent and have been identified as eligible to participate in this study on the basis of the inclusion and exclusion criteria. This section introduces the preoperative, surgical and postoperative management of subjects in detail.

6.3.1 Patient Screening Assessments

1） History
2） Physical examination
3） Hematuria pregnancy test (if required)

6.3.2 Pre-Procedure Managements

1） Fasting for 6 hours and water deprivation for 2 hours before examination
2） Routine stomach preparation.
3） Psychological counseling.
4） Performing routine anesthesia for painless gastroscopy patients.

6.3.3 Intraoperative Managements

1） Patient position: lateral position with appropriate restraint.
2） Insertion route: according to the actual situation of the subject, usually through the esophagus
3） Routine observation

6.3.4 Post-operative Managements

1） Postoperative routine nursing
2） Subjects were observed to wake up
3） Patients without pancreatic lesions and other lesions were followed up until the patient woke up and left the endoscopic room.
4） Patients with pancreatic lesions and other lesions detected should be followed up for 7 days after the EUS.
5） Record complications (if any).

6.4 Suspension and withdrawal

Patients who were screened and confirmed to be eligible for the study, signed the informed consent and completed the randomization were considered as enrolled. If serious program deviation, withdrawal, or death occurs, the subject study is considered to be suspended. If the subject discontinues the study after obtaining informed consent, the data before the discontinuation will still be included in the study-related analysis.

6.4.1Pre-Procedure

In any time during the study period, even before EUS, participants could withdraw their informed consent whenever necessary. Researchers can withdraw participants before surgery according to safety considerations in the inclusion and exclusion criteria.

6.4.2 Intraprocedure

For safety reasons, the investigator may have the subject quit during the procedure. For example, the patient is not suitable for receiving the instrument for the study or the endoscopists do not use the specified instrument for any reason. If the following serious cases occur, please withdraw during the operation:

1） Perforation
2） Bleeding
3） Allergy to narcotic drugs
4） Unable to complete EUS due to obstruction or other reasons

6.4.3 Replacement

Subject will be deemed to have commenced the study upon completion of the informed consent process, and any subject who has been discontinued prior to or during the EUS examination will not subsequently be replaced by other subjects.

6.5 Randomization and Blinding

6.5.1 Randomization Implementation

Randomization is conducted according to the study protocol, and the random contents are implemented in an electronic system block-randomized manner (n = 4; experimental group/control group = 1). Randomization prior to EUS to decide whether to use EndoAngel. The researchers randomized the random results generated by the electronic system, and the generated random results were stored in the research center. The random time (accurate to minute), random person, subject number and acronym were recorded in the corresponding positions of the electronic system.

6.5.2 Blinding Implementation and Protection

Subjects and evaluators are blinded according to the protocol.

Randomization results will be kept confidential to the subjects in general. Randomization results are not reflected in inpatient history and other subject access documents. During and after the examination, study personnel should take care not to talk to the subject about the results of the randomization to avoid unnecessary unblinding

The assessors are blinded, and the data analysis team and pathologists could not obtain the randomization results from the medical history data.

6.5.3 Unblinding

Uncovering or breaking the blindness means displaying the randomized results to the subjects or evaluators. Researchers should protect the blind method as far as possible. Uncovering the randomized results of a single subject may lead to the leakage of the randomized results of other subjects. Any leakage of the randomized results will have a significant impact on statistical analysis. In general, it is prudent to deal with the disclosure of blind law. In the following cases, it is possible to consider the disclosure of blind law:

1) endangering the safety of subjects: For example, in some serious adverse events, subjects need to know the randomized results to inform other physicians to take appropriate emergency treatment.
2) Threatening the safety of the assessor: When the assessor is facing potential safety hazards, he needs to know the randomization results.
3) Compliance: For reasons of partial compliance, in certain circumstances, if the research instruments and cases involved in unexpected adverse events are needed, the results of randomization should be made public to the relevant departments or the public.
5) Other management reasons.

6.6 Concomitant therapy and medication

The concomitant treatment and concomitant medication were recorded from the time the subject signed the informed consent to the time the study was completed. Concomitant treatment and concomitant medication should be recorded in the CRF, or a clear copy of the form available from the research center should be kept in the CRF as research data to identify other factors affecting the end of the study. When recording the concomitant treatment and concomitant medication, the indications and the starting and ending time of use should be clearly defined, and the corresponding types of adverse events should be indicated for the treatment measures to cope with adverse events. When using a copy of the study center form, the investigator should sign the copy and indicate the date of review to confirm that the document is a study document.

7. Basis of study protocol and risk/benefit analysis

EndoAngel is used to provide assistant to monitor the operation of endoscopists, which will not provide diagnosis. Doctors make their own diagnosis on the basis of EndoAngel's results. The security of the software and the improvement of endoscopic physician's diagnosis and treatment level have also been confirmed in the previous feasibility study. And the patients in this study carry out the diagnosis and treatment according to the conventional treatment measures, which are formulated in accordance with the standard medical treatment procedures and do not increase the risk of the subjects.

7.1. Selection of endpoints

1、The primary outcome of the study are the Missed scanning rate of adjacent important anatomical structures in pancreatic endoscopic ultrasonography.

The secondary outcomes of this study were: 1.Pancreatic lesions detection rate; 2.Cholangiopancreatic duct lesions detection rate; 3.The average number of scanning in the pancreatic standard station of endoscopic ultrasonography; 4.Detection rate of lesions in different pancreatic standard stations of endoscopic ultrasonography; 5.Missed scanning rate of adjacent vital anatomical structures in different pancreatic standard stations of endoscopic ultrasonography; 6.Mean scanning time in different pancreatic standard stations of endoscopic ultrasonography.

Adverse events in safety indicators shall be judged in accordance with relevant regulations, and serious adverse events shall be recorded and reported in accordance with regulations.

Other evaluations are detailed in the Case Report Form (CRF).

7.2. Definition of participants

Patients were included according to the indications and contraindications described in the use

plan. Because of practical reasons (such as younger patients, participation in a number of clinical studies, alcohol/drug dependence patients, and other factors that may affect the completion and/or reliability of gastroscopy) and ethical reasons (whether informed consent can be completed, etc.), the entry and discharge criteria have been reduced.

7.3. Adverse events

The relevant definitions of adverse events are as follows:

Adverse Events (AE): Any adverse medical event, unexpected disease or injury, or adverse clinical manifestations (including abnormal laboratory findings) that occur in a subject, user or other person, whether or not associated with medical devices.

Serious Adverse Events (SAE): Adverse Events with the following information:
- causing death.
- leading to severe deterioration of the health of the subjects, including
- leading to life-threatening diseases or injuries,
- Causing impairment of body structure or function.
- Need hospitalization or extended hospitalization
- lead to hospitalization and preventive medical or surgical intervention
- Permanent damage to body structure or function
- Fetal distress, fetal death or congenital abnormalities or congenital defects.

Note: Hospitalization for existing conditions, or surgery required in the program, without serious deterioration of health status, is not considered a serious adverse event. Purposeful hospitalization, such as economic or reimbursement reasons, is not considered a serious adverse event.

Unexpected adverse device response (UADE): refers to adverse events related to medical devices that were not previously identified in the current version of the risk analysis report in terms of nature, severity or incidence. The definition includes any event caused by insufficient or inadequate description of the use or deployment of the device. This definition includes any event caused by a user's error.

7.4. Expected and trial-related adverse events

Previous studies have shown that the expected adverse events are basically the same as the complications of conventional endoscopic diagnosis and treatment.

The instrument used in this experiment is a medical software which is not in contact with human body. There is no difference between the experimental operation and the routine operation. The intervention measures (such as randomized process) in the experiment may slightly increase

the incidents of diagnosis and treatment.

7.5. Risk minimization

In this study, when there are bugs in the software, doctors can still operate under their own judgment without affecting conventional diagnostic and treatment measures, greatly reducing the risk of the test.

7.6. Related benifits

Subjects will be randomly assigned to an experimental group or a control group. And experimental subjects may increase the detection of pancreatic lesions and other lesions.

7.7. Overall feasibility analysis

EndoAngel is an independent system including both software and computer hardware, which can monitor image data 24 hours a day. The system is not invasive. The overall operability is strong.

8. Statistical Analysis

8.1. Statistical Analysis Plan

Data management and statistical analysis were implemented by Renmin Hospital Wuhan University.

8.2. Methods

Continuous variables should be described by number of subjects, mean, standard deviation, median, minimum and maximum.The classification variables are summarized by frequency and percentage.

8.3. Hypothetical test

The main assumptions are:

1. The use of EndoAngel can reduce the missed scanning rate of adjacent important anatomical structures in pancreatic endoscopic ultrasonography.
2. The use of EndoAngel can improve the the detection rate of Pancreatic lesions.

8.4. Sample Size Calculation

We mainly studied the effect of EndoAngel on the the quality of EUS scanningfor physicians.Therefore, data collection and analysis were conducted for the main effect. It is expected that a total of 285 subjects will be enrolled. Assuming the missed scanning rate of adjacent important anatomical structures in experimental group is 8%, the missed scanning rate of adjacent important anatomical structures in control group is 20%. Bilateral significance level 5% (alpha =5%), assurance 80% (beta =20%), shedding rate 10%, Expected to enroll 285 patients in total.

8.5. Statistical analysis set

All patients who met the inclusion and exclusion criteria were considered eligible for recruitment.

The two analysis sets in this study are defined as follows:

• The full analysis set (FAS) population analysis set will contain all eligible cases and shedding cases, but does not include culling cases.

• The Compliance (PP) population analysis set will include all subjects in the FAS analysis set with no significant deviation from the program.

Intention-to-treat and conformity analysis sets should be used to analyze the primary efficacy endpoints. The main analysis will be based on the PP analysis set. FAS analysis was regarded as supportive analysis.

9. Device Description

EndoAngel
Version: EA 2301

10. Abbreviations

Abbreviations	Full Name	Chinese
AE	Adverse Event	不良事件
CFDA	China Food and Drug Administration	国家食品药品监督管理总局
CNDA	China National Drug Administration	国家食品药品监督管理总局
CRF	Clinical Record File	病例报告表
CTCAE	Common Terminology Criteria for Adverse Events	不良事件常规评价标准
EC	Ethical Committee	伦理委员会
ICD	Informed Consent Document	知情同意文件
ICF	Informed Consent Form	知情同意书

ITT	Intention to Treat	意向治疗分析集
PP	Per Protocol	符合方案集
SAE	Serious Adverse Event	严重不良事件
EUS	Endoscopic ultrasonography	超声内镜
EUS-FNA	Endoscopic Ultrasound Guided Fine Needle Aspiration	超声内镜引导下细针穿刺活检

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Informed Consent Form

"A single-center study on the efficacy and safety of Artificial Intelligence-assisted navigation system for pancreatic endoscopic ultrasonography"

Informed Consent Form for clinical study subjects

Informed Consent Form:Information page

Release date: 1.1,12 December 2019

Principal investigator: Yu Honggang

Dear sir / Madam,

We will invite you to participate in a clinical study "A single-center study on the efficacy and safety of Artificial Intelligence-assisted navigation system for pancreatic endoscopic ultrasonography". During this study, we will use a new EUS-assisted system which do not interfere the physician's original observations and procedures.

Before you decide whether to participate in the study, please read the following as carefully as possible to help you understand the study and why it was conducted, the procedure and duration of the study, the potential benefits or risks of participating in the study. If you wish, you can discuss it with your family or friends, or ask your doctor for an explanation to help you make a decision

1.Background and Purpose

Pancreatic cancer is a malignant tumor of the digestive system with insidious onset, rapid progression and very poor prognosis. According to the latest cancer data in China in 2020 released by the International Agency for Research on Cancer (IARC) of the World Health Organization, there are about 120,000 new cases of pancreatic cancer in China, with a mortality rate close to 100%, which seriously endangers the national health. Early diagnosis of pancreatic cancer can be achieved by surgical resection with a 5-year survival rate of 58%, Once advanced pancreatic cancer develops, patient survival is 7.2%. As a rapidly developing deadly cancer, missed diagnosis of pancreatic cancer may have extremely serious consequences for patients.How to improve the diagnostic rate of early pancreatic cancer is an urgent problem to be solved.

EUS(endoscopic ultrasonography) is considered one of the most sensitive modalities for pancreatic cancer detection. It has a much higher diagnostic accuracy than MRI and CT for the diagnosis of pancreatic cancer, especially early pancreatic cancer < 1 cm in diameter (EUS-FNA 95.6% vs CT 77.4%, MRI 76.2%). EUS is the modality of choice for the early diagnosis of

pancreatic tumors. To avoid a missed diagnosis of the pancreatic cancer, the continuity and integrity of EUS needs to be ensured as much as possible. But EUS is highly operator-dependent and the learning curve is steep, and the quality of the examination is highly dependent on the operator's technique. Therefore, it is necessary to develop a system that can effectively assist the full scanning of EUS.

The station approach in pancreatic EUS has been established as the standard scanning procedure. The principle of completing the station approach is to find the anatomical landmarks of this station, Such as organs (kidney, spleen), blood vessels (such as splenic artery, splenic vein, portal vein), ducts (pancreatic duct, bile duct), etc.The scanning of these anatomical landmarks is the basis for an accurate assessment of the entire pancreas。

At the same time, the type of pancreatic lesions and the development of the course have abnormal imaging findings of different anatomical structure. For example, ultrasound images of pancreatic cancer will show vascular invasion, deformation of the biliopancreatic duct, and metastasis of adjacent organs. The guidelines clearly require that the choice of surgical approach for pancreatic cancer needs to be based on the degree of invasion of the cancer to adjacent important anatomical structures, to maximize the volume sparing of functional pancreatic parenchyma. Complete anatomical scanning can assist in the diagnosis of pancreatic lesions and guide patient treatment and prognosis.

In recent years, artificial intelligence (AI) has been successfully applied in multiple medical fields. At present, there have been studies of AI-based endoscopic ultrasonography for the identification of pancreatic lesions, However, there are no studies of AI-based navigation system for pancreatic endoscopic ultrasonography. Previously, we have successfully developed a standard station scanning navigation system for the pancreas and bile ducts. This system can improve the recognition accuracy of endoscopists for standard stations and enhance the cognitive ability of endoscopic ultrasonography images.

Based on the previous, we constructed a deep learning-based pancreatic scanning navigation system in EUS, which can assist in identifying important anatomical structures adjacent to the pancreas in real time. and verify its auxiliary performance for endoscopists in clinical practice. In order to improve the quality of EUS and reduce the missed diagnosis of pancreatic lesions.

2.Who can participate in the study

1)Male or female aged 18 or above;
2)EUS is needed to further clarify the characteristics of digestive tract diseases;
3)Patients able to give informed consent were eligible to participate.
4)Able and willing to comply with all study process.

3.Who can not participate in the study

1)Has participated in other clinical trials, signed informed consent and was in the follow-up period of other clinical trials.
2)Has participated in clinical trials of the drug and is in the elution period of the experimental drug or control drug.
3)Drug or alcohol abuse or psychological disorder in the last 5 years.
4)Patients in pregnancy or lactation.
5)A history of Upper Gastrointestinal surgery.

6)Patients with anatomical abnormalities of the upper gastrointestinal tract due to advanced neoplasia

7)Patients in whom the presence of clearly defined vital anatomical structures cannot be observed

8)Researchers believe that the patient is not suitable to participate in the trial.

4.What would you need to do

Patients need to prepare for EUS routinely, fasting for at least 6 hours and water deprivation for at least 2 hours before the procedure. Patients undergoing painless operation receive general anesthesia, while patients undergoing general operation do not need it. If you are assigned to the experimental group, the endoscopists will be assisted by EndoAngel, which can assist in identifying important anatomical structures adjacent to the pancreas in real time. If you are assigned to the control group, the endoscopist performs the examination routinely without special prompts. You are equally likely to be in the above two groups

5.Benefits

You will be randomized into the experimental group and the control group. The endoscopists in the experimental group will be assisted by EndoAngel, which can assist in identifying important anatomical structures adjacent to the pancreas in real time. Patients who have access to the EUS with EndoAngel will likely have a better view of the lesion, a higher exam quality, and more comprehensive disease information.

6.Adverse events

The adverse events are basically the same as the complications of conventional endoscopic diagnosis and treatment.Participation in this study does not increase other additional risks.

7.Related fees

Routine EUS for your clinical examination items, the cost of your own. Participation in this study does not involve additional testing and does not increase the cost of your care.

8.Personal Information

During the EUS process, your EUS electronic images and case information will be collected and preserved in the hospital. Your doctor, the researcher, will be given access to this electronic information for scientific research. Your personal identity will not be disclosed in any public report of the results of the relevant research and development. We will do everything within the law to protect the privacy of your personal medical data.

9.For more information

You can ask any question about this study at any time.

Your doctor will give you his or her phone number so that he or she can answer your questions

Your doctor will keep you informed if there is any important new information during the course of the study that may affect your willingness to continue participating in the study.

10.Participation and withdrawal are voluntary

Participation in the study is entirely up to you. You may refuse to participate in the study or withdraw from the study at any time during the course of the study. You will not be discriminated against or retaliated against for refusing to participate in the study. Your medical treatment and entitlements will not be affected.

Your doctor or researcher may suspend your participation at any time in the best interest of you.

If you withdraw from the study for any reason, you may also be required to undergo a

laboratory and physical examination if your doctor deems it necessary.

If you choose to participate in this study, we hope that you can adhere to the completion of the entire research process.

11.Others

Participation in this study is up to you. You can discuss it with your family or friends before making a decision.

Before you decide to participate in the study, ask your doctor as many questions as you can about the study until you have a complete understanding of it.

Thank you for reading this. If you decide to participate in the study, please tell your doctor, he or she will arrange for you to participate in all matters related to the study. Please keep this information.

Informed Consent Form:Information page

Name of Clinical Research Project： A single-center study on the efficacy and safety of Artificial Intelligence-assisted navigation system for pancreatic endoscopic ultrasonography

Research physician commitment:

As a research physician, I confirmed that I had clearly explained to the subject the details of this trial, including their rights and possible benefits and risks, and gave them a signed copy of my informed consent.

Name：_____ Date;_____

Contact：_____

Subject commitment:

I have read and understood the introduction to this study on the informed consent page, and have had the opportunity to ask questions. I understand the research physician's explanation.

I am aware of the risks and benefits of participating in this study. I am aware that participation in the study is voluntary, and I am sure that there has sufficient time to consider and volunteer for the trial. I can always ask my doctor for more information, and I can always withdraw from the study without discrimination or retaliation, and without prejudice to medical benefits and entitlements.

I also knew that if I dropped out of the study, I would tell my doctor and complete the physical and chemical tests. If I need to take any other medication for my illness, I will consult with my doctor in advance or tell him the truth afterwards.

I agree☐ or refuse☐ Use my medical records for any other study.

I agree to participate in the study and promised to follow the doctor's advice to the best of my ability. I will receive a signed and dated copy of the Informed Consent Form.

Name：_____ Date;_____

Contact：_____

-End-