TITLE: **3D ROTATIONAL CT ANGIOGRAM WITH EMBOLIZATION GUIDANCE AND CBCT IN PROSTATE ARTERY EMBOLIZATION**

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National Clinical Trial Identifier: NCT03164629

VERSION: B

Date of Protocol: **February 20, 2018**

1) **Protocol Title**
   3D Rotational CT angiogram with Embolization guidance and CBCT in Prostatic Artery Embolization
2) **Primary Objective**
   To ascertain the feasibility of cone-beam CT with Embolization Guidance software (Emboguide) to identify prostatic arteries and assist endovascular navigation, by projecting a 3D road map of prostatic arteries on live fluoroscopy, in order to differentiate them from non-target vessels. **The primary outcome measurement will be the time for prostatic artery catheterization.**
   - For the cases using Emboguide this will be measured as the time from which the Emboguide is displayed on the live fluoroscopy to the time of prostatic artery catheterization. Emboguide display is in addition to the angiogram roadmap display.
   - For the control cases this will be measured as the time from which the angiogram is displayed on the live fluoroscopy to the time of prostatic artery catheterization.

3) **Background**

Direct clinical translation – University of Miami has been performing Prostatic Artery Embolization (PAE) since 2014 and has significant experience with the procedure. Technical challenges are encountered on a routine basis. The combination of 3D rotational CT, Emboguide and cone beam CT has tremendous potential to standardize and optimize a software protocol to aid in identification, catheterization, and embolization during the technically challenging PAE procedure. The data from this feasibility study might be used for a subsequent grant proposal (individually or in conjunction with other proposals) to improve the safety and efficacy of PAE.

The proposed study is a proof of concept investigation to assess a new clinical application. Current technical challenges to the widespread adoption of PAE include identification and catheterization of arteries appropriate for embolization. Prostate arteries are frequently tortuous, with duplication or replacement and varying sites of origin, and due to the nature of the patient population, atherosclerosis further complicates identification and navigation. An imaging system that could assist with identification and catheterization has the potential to improve patient outcomes by facilitating more complete embolization, avoidance of non-target vessel occlusions, and reduction of radiation exposure time.
With the current proposal, the software application can be standardized and tailored to optimize safety and efficacy of prostate embolization, which has been shown in clinical trials to be an effective alternative treatment of enlarged prostate or bladder outlet obstruction.

Another advantage of the protocol is it may obviate the need for pre-procedure CT angiogram, further reducing radiation exposure and procedure time.

4) **Inclusion and Exclusion Criteria***

Inclusion criteria:

1) Patient is age 50 to 79, inclusive
2) Patients undergoing Prostate artery embolization for BPH or urinary retention
3) Patient has signed informed consent (able to consent).

Exclusion criteria:

1) Patients with biopsy proven prostate cancer
2) Patient weight of >300 lbs.

5) **Local Number of Subjects***

Approximately 50 patients will be enrolled at this investigator site no screening failures are anticipated since all 50 patients will receive PAE and cone-beam CT. Currently cone-beam CT is performed routinely for all PAE cases. 25 sequential patients will undergo PAE with 3D angiogram and Emboguide. This will be followed by 25 sequential patients who will undergo PAE with no 3D angiogram nor Emboguide.

6) **Study Timelines***

The study duration will be approximately one year from the start date. The enrollment will take about 8 months and data analysis will take about 3 months.

7) **Study Design/Procedures Involved**

This is a single center prospective study. The patients eligible for the PAE for benign prostate hyperplasia will be offered the study and inform consent will be obtained. Once patient has been referred to Interventional Radiology (IR) and prior to the clinic visit with the IR physician, the records of the patient will be accessed for screening purposes. Patients will be recruited for participation in the study during routine consultation for the prostate embolization procedure. The main challenge of the PAE procedure remains the identification of the prostatic arteries and their super-selective catheterization. Contrast enhanced cone-beam CT (Dyna-CT) is already performed at our center as part of the PAE clinical protocol to reduce the risk of non-target embolization, especially to the rectal, bladder and penile vasculature. We will initially obtain a 3D rotational selective angiography of the internal iliac artery for study group. This dataset will be called the PLANNING dataset. We will assess if superimposing the pre-catheterization 3D dataset (in which the physician marks the prostate and its arterial feeders), can be used as an Emboguide tool along with overlay from a conventional DSA. This will be transmitted to live fluoroscopy and be used as an aid to catheterization of the prostatic arteries in the study group.

Study Group

The following parameters will be recorded for the study group:

- Time for catheterization as defined above
- Time for planning dataset for each side
- Total dose area product
- Dose for planning dataset for each side
- Dose area product only for fluoroscopy
- Total procedural time: **from access to closure**
- Amount of contrast medium used

Control Group

The following parameters will be recorded for the control group:

- Time for catheterization as defined above
- Total dose area product
- Dose area product only for fluoroscopy
- Total procedural time: **from access to closure**.
- Amount of contrast medium used

The tortuosity of the vessels will be graded in each case and will be categorized into:
1- Mild
2- Moderate
3- Severe

This will be graded visually for every case and will be noted on the case report forms. We will also study the arterial supply to the prostate gland with any anatomic variants including duplicated prostatic arteries or prostate arteries arising from less common branches such as common gluteal-pudendal trunk, obturator artery, and inferior gluteal artery in all patients.

8) **Data Storage**
All data collected will be stored in a password protected database in a password protected computer of Interventional Radiology to which only the PI and study coordinator or other key research personnel have access.
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9) **Data Management***
The statistical analysis for the current study will be conducted as follows. The following variables and parameters will be collected:

- Time for catheterization

- Time for planning dataset for each side (This will be evaluated as the time from completion of the 3D angiogram to beginning of catheterization)
- Total dose area product,
- Dose for planning dataset for each side,
- Dose area product for fluoroscopy only,
- Total procedure time, and
- The amount of contrast media used.

Descriptive statistics (mean, median, range, and standard deviation) will be computed for the treatment group and the control group and values will be compared for the variables of interest.

Additionally, a statistical significance comparison between the study group (with guidance) and the control group (without guidance) will be computed for several parameters. Specifically, the differences in means and/or medians between the following variables and parameters will be analyzed using a T-test or a Mann-Whitney test (depending on normality of the distribution and other assumptions):

- Time for prostate artery catheterization for each group
- Total dose area product (this will include DAP from the planning dataset in the study group)
- Dose area product only for fluoroscopy,
- Total procedure time, and
- The amount of contrast medium used.

10) **Withdraw of Subject**

Patients can withdraw from the study at any time, without penalty or benefit. This study may be discontinued, without the patients consent, at any time by the study doctor, if he/she believes that participation in the study is no longer in their best interest.

11) **Risks to Subjects***

Subjects will have one or more medical imaging studies (x-ray like films) which use radiation (emission or transmission of energy in the form of waves or particles)**.** The tests or treatments include a whole body CT scan. To give an idea about how much radiation **the patients** will get, we will make a comparison with an every-day situation. Everyone receives a small amount of radiation that cannot be avoided each year. Some of this radiation comes from space and some from naturally-occurring radioactive forms of water and minerals. This research gives your body the equivalent of about 3 extra years' worth of this natural radiation. Subjects will be exposed to radiation as per their standard of care treatment. The investigational group will be subject to additional radiation for the 3D

planning dataset, however this in turn might reduce the duration of prostate artery catheterization leading to similar or reduced radiation if the 3D dataset was not used.

12) **Potential Benefits to Subjects***

There are no current direct benefits for patients, however there may be advantages to future patients if it is determined that this technology can obviate the need for pre-procedure CT angiogram and increase the safety of the procedure by reducing the risk of non-target embolization.

13) **Sharing of Results with Subjects***

The results will not be shared with subjects as there is no direct advantage to the patient and they are not related to clinical outcomes of the procedure.

14) **Setting**

Patients will be identify and recruited at PAC Radiology Clinic. The study procedures will be performed at UMHC.

15) **Recruitment**

Patients who require PAE will be referred by their Urologist or will visit an Interventional radiologist. This is a single center study. The patients eligible for the PAE for BPH will be offered the study and informed consent will be obtained. Patients will be recruited for participation in the study during routine consultation for the prostate embolization procedure.

16) **Confidentiality**

Subject study files will be stored in a double locked cabinet to which only the investigators and research team have access. The address is 1400 NW 10th Avenue Suite 1114, Miami, Florida 33136. The only member(s) of the study team with access to it will be Lia Quezada. The data will be stored for up to 2-3 years after the study is completed and will be destroyed in accordance with university policies thereafter.

17) **Provisions to Protect the Privacy Interests of Subjects**

The Investigators and research team will ensure that the subject understands that only their information from the procedure will be collected. No other follow up visits will occur. All study records will identify patients by study identification number.

18) **Compensation for Research-Related Injury**

Subjects will not be compensated.

19) **Economic Burden to Subjects**

Subjects will bear the cost that they will normally pay for their standard of care procedure but no additional costs associated with participation in the study.

20) **Consent Process**

Written Informed consent and HIPAA forms will be obtained to collect the data from those prospective subjects who agree to participate. Three copies will be obtained, the original will be kept in the subject's file with the research team, the second will be provided to the patient and last will be placed in the medical record so it can be scanned to UChart.

A partial waiver of HIPAA for screening purposes is being requested. Once patient has been referred to Interventional Radiology (IR) and prior to the clinic visit with the IR physician, the records of the patient will be accessed for screening purposes.

Non-English Speaking Subjects: The ICF will be translated into Spanish once we have received approval from the IRB.

21) **Process to Document Consent in Writing**

The research team will document the informed consent process for every participant who will prospectively participate in the study. Patients will be consented at PAC Clinic.
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22) **Drugs or Devices**

The device is the cone-beam CT 3D Embolization guidance software which is currently being used at UMHC for Interventional radiology clinical purpose only.

23) **Resources Available**

The Interventional Radiology Department has 14 IR attending physicians well trained in the fields of Interventional Radiology and Interventional Oncology. It also has a dedicated research team:

Lia Quezada, BA: Clinical Research Coordinator has been in research since 2007