Safety and Efficacy of Hyperosmolar Saline Irrigation Fluid in Arthroscopic Knee Surgery

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1. Background Information & Significance

An isotonic solution, such as saline (0.9%, 300mOsm/L) or lactated ringer's (273 mOsm/L), is commonly used and safely proven for joint irrigation during arthroscopy. Arthroscopic fluid is usually pressurized to enable visualization through dilation of the joint or bursa and prevent bleeding from the microvasculature. It has been recommended that this pressure be maintained at 49mmHg or less below the systolic blood pressure to preserve the clarity of view. The combination of large amounts of pressurized irrigation solution and lengthy arthroscopic procedures may cause substantial tissue fluid retention. Thus, extravasation of irrigation fluid into the periarticular tissues is inevitable and may create technical difficulties as well as patient morbidity and complications. Previous investigators have reported complications including tracheal obstruction, post-operative airway edema and compromise leading to prolonged intubation, excess weight gain, neurologic injuries, skin necrosis, and fluid overload associated with excessive fluid extravasation and tissue retention. Furthermore, it has been shown that fluid accumulated during the operation is slowly released back into the systemic circulation. Although there is not a rapid change in circulating volume, there may be implications for elderly patients and those with multiple comorbidities during prolonged arthroscopic surgery. Our research team and other groups have reported that hyperosmolar solutions (up to 600 mOsm/L) are chondroprotective *in vitro,* and safe and effective clinically when used as the irrigation solution for arthroscopic shoulder surgeries in a prospective controlled randomized clinical trial.

2. Objectives, Contribution, & Hypothesis

Objectives: To determine if a hyperosmolar solution, similar to what is used in head trauma patients, can reduce the degree of fluid extravasation in knee arthroscopy. To determine if a hyperosmolar solution has any effect on post-operative knee pain compared to the standard isotonic solution. To determine if a hyperosmolar solution has any effect on post-operative pain medicine consumption compared to the standard isotonic solution.

Contribution: The potential benefits of this study lie in determining the differences noted in our shoulder arthroscopy clinical trial extend to arthroscopic knee procedures.

Hypothesis: A hyperosmolar irrigation solution used in knee arthroscopy will reduce the extent of fluid extravasation to surrounding tissue, decrease perioperative pain, and result in diminished utilization of perioperative pain medication.

3. Selection of Subjects

Inclusion Criteria: Adult patients (18 years of age or greater) undergoing arthroscopic knee surgery who are willing and able to consent.

Exclusion Criteria: Current pregnancy or breastfeeding; Unable to give consent; Prisoner; Mentally Disabled.

Sample Size: We anticipate enrolling up to 100 patients to complete the study. Patients will be evenly randomized to either hyperosmolar or standard irrigation solution.

4. Study Procedure

Timeline: 12-24 months of data collection

Protocol: Study candidates will be identified as they present to the clinic at the Missouri Orthopaedic Institute at the University of Missouri, and will be evaluated by one of our three sports orthopaedic surgeon co-investigators. Informed consent will be obtained as per IRB protocol. Enrollees will receive a copy of the study protocol, consent, and HIPAA form. Background patient information will be collected including age, sex, BMI and co-morbidities. American Society of Anesthesiologist (ASA) classification will be assigned by the involved anesthesiologist.

Lactate Ringer's (LR, 273mOsm/L) is commonly used at our facility as our isotonic standard irrigation solution and will serve as the control to be evaluated against a hyperosmolar (1.9%, 600mOsm) solution. The hyperosmolar solution will be created by adding 120cc of 23.4% NS solution to a 3L bag of LR. The patient will be randomized before surgery by a research team member by obtaining a sealed envelope that designates the type of irrigation solution to be used in the surgery. If randomized to the hyperosmolar group, an OR staff member will make the solution prior to the start of the case. The surgeon and patient will be blinded to the type of irrigation solution used in surgery.

Quantitative variables that will be recorded include, pre and post-operative blood pressure, the type and amount (mL) of irrigation fluid used, amount of intravenous fluid used (mL), pre and post-operative weight (lb), procedures performed, number of portals, arthroscopic surgical time (minutes), pre and post-operative knee girth measurements (cm), and amount of perioperative opioid medication. We will also document any immediate, post-operative adverse effects (ie, airway comprise, prolonged intubation, etc.).

Weight: On the day of surgery, the patient's weight will be measured to the closest one tenth of a pound (lb) before and after surgery on the same calibrated, digital weighing scale. Patients will be weighed while wearing the same attire and hospital gown for each measurement. After surgery, patients will be weighed before discharge and before voiding or eating to ensure that the maximal amount of weight gain attributable to shoulder arthroscopy can be documented. A standard amount of dressing will be applied for each procedure that is surgeon specific and will be accounted for during the calculation of weight gain. Intraoperatively, we will record the

amount of intravenous fluid given during the case (mL).

Knee Girth: Change in knee size (girth) will be evaluated based on change in surface area. Prior to start of the surgery, a sterile measuring tape will be used to record knee girth. Following the surgical procedure the operating surgeon will perform a repeat measuring of the knee girth. During the assessment, the patients will lay supine with the tester aiming to maintain the hip in neutral position. The knee will be relaxed and extended as much as possible. If the knee extends below 0°, a cylinder firm back roll will be placed under the heel of the foot. The tester will stand closest to the examined leg and place a small dot with a pen 1 cm proximal to the base of the patella using a non-elastic tape measure. The mark will be removed between measurements. The tape measure will be placed carefully and snug above the dot, and the tester will measured the knee joint circumference. The tape measure will be blinded on the side facing the tester. When the tester is satisfied with the alignment of the tape measure, the unblinded scale will be revealed to the data recorder. The value will be recorded to the nearest 0.1 cm and the measurement will be repeated. The highest value of the two knee circumference recordings will be used in the data analysis

Prior to departure from the hospital, the patient will be given the option to either receive a paper copy of the Pain Evaluation form or have an electronic version sent to them (through Patient IQ) each day. The patient will be instructed to write down their pain level (based on the Visual Analog Score, 0-10) and amount of pain medication taken during each day from the day of surgery to post-operative day 3. If given the paper form, the patient will return this form at his/her first post-operative clinic visit.

Approximately 1 year after surgery, patients will be contacted via telephone by a member of the research team. A telephone questionnaire will be conducted to gain additional information about their recovery and current functional status. The phone interview will include questions pertaining to three outcome measures: 1) KOOS Jr, 2) Single Assessment Numeric Evaluation (SANE) score for their knee, and 3) Data collection regarding any additional surgeries involving the affected shoulder.

5. Confidentiality of Data

Patient confidentiality during the course of this study will be protected in compliance with HIPAA requirements as well as the requirements of the University of Missouri Health-Sciences IRB.

All subjects will be assigned a study identification number that requires the use of a key in order to decipher a subject's personal identification information. The key will be kept in the Cerner Power Trials database, which is password protected. The study identification number will be used to label all paper data collection instruments.

All subject information in electronic format will be kept in password-protected storage. All subject information in paper format will be kept in locked cabinets in a secured suite at the

Missouri Orthopedic Institute, and otherwise will be archived in a secure storage facility, or destroyed.

6. Assessment of Risks & Benefits

Risks: Risks for breach of confidentiality does exist but will be limited with tight control and limited access to the investigators.

Benefits: The potential benefits of this study lie in determining the differences noted in our shoulder arthroscopy clinical trial extend to arthroscopic knee procedures.

Data Safety Monitoring Plan: Subject safety will be ensured through standard of care perioperative monitoring by the anesthesia staff.

7. Payment and Remuneration, and Costs

Payment and Remuneration: Participants will not receive payment for participating in this study.

Costs: Subjects will be responsible for the cost of any surgical and clinic follow up costs. The treatment arm does not in any way effect the costs that patients are experiencing.

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