Barbed Suture: A Look at Its Use for Hysterotomy Closure During Cesarean Section
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Protocol
Title: Barbed Suture: A Look at its Use for Hysterotomy Closure During Cesarean Sections
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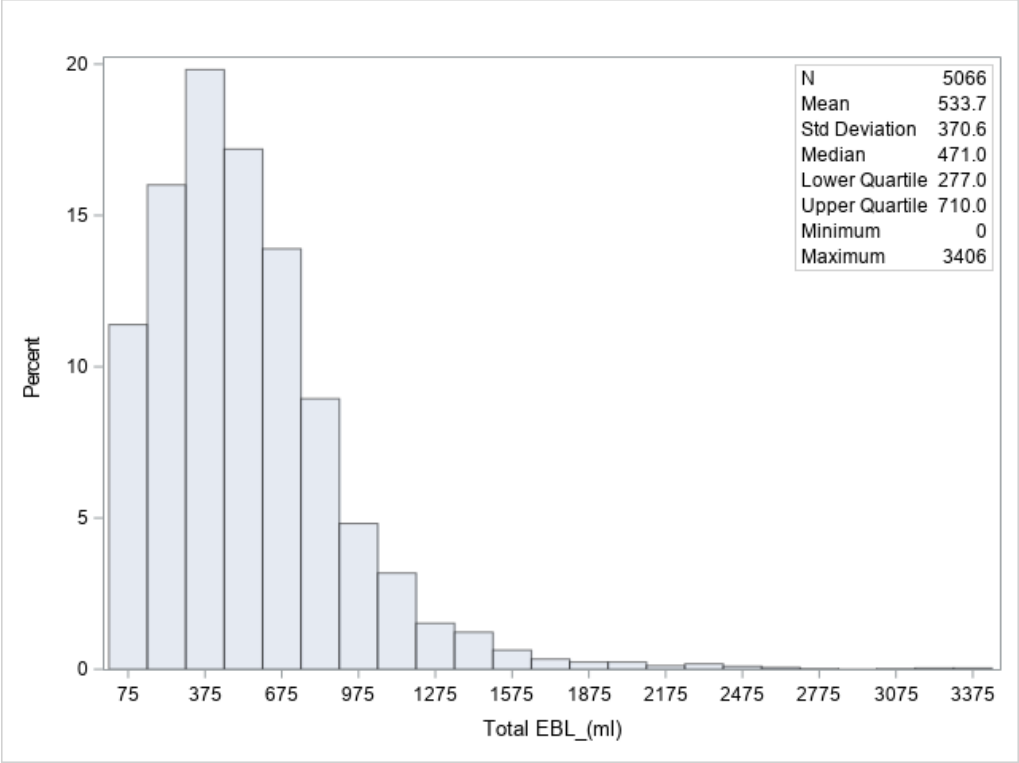
Background: Surgical knot tying is a central part of any procedure and a crucial part of surgical technique. However, while it is a means of tissue approximation, more importantly, knot tying plays a role in anchoring the suture to the tissue. Knot tying also introduces human error and interuser variability given the innate differences in ability to tie a secure knot (1). Barbed suture has pioneered the way for knot-less surgical technique, thereby decreasing some of the human error associated with the process of tying a knot. Bidirectional barbed suture incorporates tiny barbs that distribute the tension along the entire suture line rather than the knotted ends as seen with traditional suture material (2). With barbed suture, no knots are required. There have been several studies looking at the use of barbed suture in gynecology and it is already in wide use in the field of minimally invasive gynecological surgery, however very few studies have looked at the use in obstetrics. Currently cesarean sections are the most common procedure performed in the United States (6) and at our institution we perform over 8,000 deliveries per year. The objective of this study is to investigate whether barbed suture conveys a decrease in quantitative blood loss when compared to conventional suture.

General Design: This is a prospective, randomized controlled trial evaluating whether using a barbed suture to close a C-section incision can reduce blood loss. Patients undergoing C-section will be randomized with equal allocation to a barbed suture or a standard antimicrobial suture. The primary outcome is quantification of blood loss (QBL). At Mount Sinai Hospital, QBL is calculated by Triton AI which captures sponge and canister images to accurately monitor blood loss in real time. Differences between the groups will be assessed using a 0.05 level Wilcoxon rank-sum test. Secondary outcomes include time for hysterotomy closure, need for additional hemostatic sutures, rate of endometritis/SSI (superficial wound infection, deep wound infection, and endometritis) within 6 weeks postpartum, use of hemostatic agents, and differences in pain which will be assessed by a telephone screening in the days following delivery. The Mann-Whitney test will be used to compare continuous outcomes between the barbed suture and antimicrobial suture groups. Continuous secondary outcomes include time for hysterotomy closure (in minutes), and difference in pain between post-surgery day 1 and day 14. The Chi-square test of Fisher's exact test (as appropriate) will be used to compare the incidence rate of binary outcomes between the two patient groups. Binary secondary outcomes include need for additional hemostatic sutures (Y/N), endometritis or surgical site infection (SSI) within 6 weeks of surgery (Y/N), and use of hemostatic agents (Y/N**). Inclusion criteria** (1) those undergoing an elective scheduled cesarean delivery at ≥ 37 weeks' gestation, (2) those in labor requiring cesarean delivery for usual obstetrical indications, or (3) those who failed a trial of labor after a previous cesarean delivery at Mount Sinai Hospital ages 18-64**. Exclusion criteria include**, multifetal gestations, placenta previas, and patients with a known coagulopathy (DIC, Von Willebrands Disease, etc). Also excluded are patients with IAI, patients on magnesium sulfate, placenta abruption, and PAS.

Sample Size: Sample size is based on a two-sided, equal variance T-test. Since the distribution of QBL is non-normal, the calculation was inflated by 15% to ensure adequate power for the nonparametric Wilcoxon rank-sum test as recommended by Lehmann (5). Based on data from C-section patients seen at Mount Sinai from 2018-2019, the distribution of QBL is assumed to have a mean of 534 and a standard deviation of 371. (Figure 1).
Figure 1. Distribution of QBL in C-Section Patients at Mount Sinai from 2018-2019



Assuming each group has a standard deviation of 371 and the control group has a mean QBL of 534, a sample size of 226 patients (113 in each group) provides ~85% power to detect a 30% decrease in mean QBL between the groups at the 0.05 significance level. Sample size for alternative effect sizes are tabled below. 300 sutures are requested by the investigators to standardize a double layer closure for all patients as is the standard of care for most Obstetricians (113 patients in the barbed suture arm, double layer would require 226 suture, we are requesting 452 suture so extra suture is available should additional hemostatic sutures be needed.

Power	Alpha	Mean QBL in Control Group	Mean QBL in Experimental Group	Standard Deviation in Both Groups	Absolute Difference of Means	Relative Difference of Means	Group N	Total N
0.85	0.05	534	267	371	267	50%	42	84
0.85	0.05	534	320.4	371	213.6	40%	65	130
0.85	0.05	534	373.8	371	160.2	30%	113	226
0.85	0.05	534	427.2	371	106.8	20%	251	502

Provisions to decrease risk

This study is greater than minimal risk, however there are no reasonably foreseeable risks to the subjects and no inconvenience as they are recruited/screened/consented during their routine prenatal care. The barbed suture is not being used outside of its scope of use. There is always a risk of breach of confidentiality.

Patients will be recruited by their obstetrical provider. To mitigate the risk of breach of confidentiality and ensure confidentiality, the following system will be adhered to: when subjects are enrolled in this study, they will be assigned a unique identification code. Corresponding medical record numbers for each code (keycode will be stored in a password locked documentation the MFM servers that can be accessed only by members of the research team. At the conclusion of the data extraction, the outcome variable will be assessed and the key codes to the medical record number will no longer be necessary, and that information will be permanently erased from the key code file. Electronic data with identifiers will be encrypted according to Data Security Standards.

Benefits

There is no direct benefit.

The benefit to society is that since barbed suture is successfully and routinely used in gynecological surgery, establishing its use in obstetrical surgery could demonstrate improvements in patient care in the form of shorter operative times, more secure tissue approximation without the introduced interuser variability due to knot tying, and decreased risk of infection and pain. As cesarean sections are the most common procedure being performed in the U.S, any advances in surgical technique would prove extremely useful.

Risk/benefit assessment

This research involves less than minimal risk. To mitigate the risk of breach of confidentiality and ensure confidentiality, the following system will be adhered to: when subjects are enrolled in this study, they will be assigned a unique identification code. Corresponding medical record numbers for each code (keycode will be stored in a password locked documentation the MFM servers that can be accessed only by members of the research team. At the conclusion of the data extraction, the outcome variable will be assessed and the key codes to the medical record number will no longer be necessary, and that information will be permanently erased from the key code file. Electronic data with identifiers will be encrypted according to Data Security Standards.

Data analysis will be performed at the halfway mark to ensure there is no inadvertent harm to the subjects. Additionally, the barbed suture will be used in the capacity of its labeled use. Therefore the potential risk to the subject is low. There is no risk to the fetus as it will be delivered prior to the intervention

There is no direct benefit.

Scientific rationale for study designer
This study is extremely feasible given 1/3 of all 8,000 deliveries performed at Mount Sinai are cesarean sections.

This is a prospective, randomized controlled trial evaluating whether using a barbed suture to close a C-section incision can reduce blood loss. Patients undergoing C-section will be randomized with equal allocation to a barbed suture or a standard antimicrobial suture. The primary outcome is quantification of blood loss (QBL). Differences between the groups will be assessed using a 0.05 level Wilcoxon rank-sum test. Secondary outcomes include time for hysterotomy closure, need for additional hemostatic sutures, rate of endometritis, use of hemostatic agents, and differences in pain which will be assessed by a telephone screening 2 weeks following delivery. The patients will be contacted by study personnel 2 weeks after delivery(they will be instructed on this upon discharge) to discuss pain control, bowel or bladder complaints, and amount of narcotic use necessitated post-operatively. Demographic information will be obtained from the electronic medical record.

Recruitment process
Participants will be identified by their obstetrical provider and research staff as meeting inclusion criteria. The research will be introduced to the patient by their treating physician. Only upon expressed interest will the subject be approached for consent by the study team. The research personnel will be notified by the patient's treating physician of the subject's interest and the research personnel will then obtain official written consent.

Alternatively, to minimize in-person interaction during the COVID pandemic, research staff will identify the patients who are eligible for the study by reviewing the sonography schedule for patients having a nuchal translucency appointment at the correct gestational age, and then reviewing pregnancy history to identify patients who also have had a previous cesarean delivery. A HIPAA Waiver of Authorization has been attached to this submission. We will send a MyChart message/email to those patients (attached) regarding the research study, with patients being able to opt-out of the study at this time. We will then send a copy of the consent form via email (secured RedCap link). They will have the opportunity to review the consent form before we call. Next, we will contact them via phone or Mount Sinai Zoom account to review the consent form and answer any questions from them. This will be documented in EPIC. They can then sign it electronically if they agree to participate. Their participation in the study will be documented in their chart via FYI and their consent form will be scanned and uploaded into media within EPIC.

The research will be introduced to the participants by the patient’s obstetrical provider. The obstetrical provider and research team will assess the patient's eligibility for the study and discuss if applicable. A consent form which details the goals and objectives of the study as well as the suture materials will be provided by the provider. Patients will be given the material to read on their own and if interested in participating, a research personnel will obtain formal

written consent and answer any questions. The provider will assess if the patient meets inclusion and exclusion criteria for participation.

Participants will undergo a medical and surgical screening prior to enrollment by their obstetrical provider. There will be no cold contacts with patients.

Consent process
The patients will be given the study information by their obstetrical provider in the third trimester once patient has been identified as meeting the inclusion criteria. If interested, the obstetrical provider will notify study personnel and personnel will obtain written consent at subsequent visits (i.e when presenting for pre-operative labs at the Martha Stewart Laboratory). Alternatively, patients will provide informed consent online and over phone/zoom to facilitate consent process while maintaining social distancing.

Product storage and preparation
The device will be stored in the locked office of one of the research personnel and will only be handles by the research team until randomization is performed and the patient is allocated to the treatment arm. Only at that time would the research personnel go into the locked office and obtain the suture material for the subject. The material would be then handed off with sterility to the scrub tech who would provide the suture to the surgeon during the procedure

Safety assessments

This research involves less than minimal risk. To mitigate the risk of breach of confidentiality and ensure confidentiality, the following system will be adhered to: when subjects are enrolled in this study, they will be assigned a unique identification code. Corresponding medical record numbers for each code (keycode will be stored in a password locked documentation the MFM servers that can be accessed only by members of the research team. At the conclusion of the data extraction, the outcome variable will be assessed and the key codes to the medical record number will no longer be necessary and that information will be permanently erased from the key code file. Electronic data with identifiers will be encrypted according to Data Security Standards.

Data handling and storage
When subjects are enrolled in this study, they will be assigned a unique anonymized identification code. All data will be entered and coded using this key-code into REDCap, a password protected and HIPAA compliant database. Corresponding medical record numbers for each code (key-code) will be stored in a password locked document on the MFM server that can be accessed only by members of the research team. At the conclusion of the data extraction, the outcome variable will be assessed and the key codes to the medical record numbers will no longer be necessary, and that information will be permanently erased from the key-code file per PPHS guidelines.

References:

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