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Case Report
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Unidirectional Barbed Sutures can be used Safely in Pediatric Gastro-Intestinal Surgery

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Abstract

Background: Since the sterilization of catgut in 1907, the essential structure of surgical suture has not been modified beyond the evolution of synthetic and blended sutures from that of a simple thread and needle until recently. First approved in 2007 for approximation of soft tissue, barbed sutures (BS) are specially engineered sutures that slide through tissue in only one direction. These sutures stay in position once placed without need for knots at each end and without need for maintaining tension during placement. To date, there are no publications that document the use of barbed sutures in gastrointestinal (GI) surgery in children. Our report consists of a short series of cases demonstrating that the use of barbed sutures in laparoscopic GI procedures in children is safe.

Methods: A retrospective chart review was performed for the four children in whom unidirectional BS – V-Loc (Medtronic, Minneapolis, MN, USA), was used for GI application, between January 01, 2013 and December 31, 2014. Variables including patient age and gender, duration of surgery and specific suture used as well as time to feeds post-operative length of stay, post-operative complications were evaluated.

Results: All procedures were completed without adverse events and without subsequent complications including wound infection and readmission for wound dehiscence or anastomosis breakdown.

Conclusions: We conclude that the use of V-Loc absorbable unidirectional barbed sutures in laparoscopic gastrointestinal anastomosis is feasible and safe in children including neonates.

Keywords: Barbed sutures; Pediatric surgery; Gastro-intestinal surgery

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Introduction

Since the sterilization of catgut in 1907, though suture materials have evolved greatly to include synthetic materials and antibacterial impregnated sutures, their essential structure has not been modified from that of a simple thread and needle. First patented in 1964 by John Alcamo, though not approved for use in the United States until 2007 for approximation of soft tissue [1], barbed sutures (BS) are specially engineered sutures that slide through tissue in only one direction.

BSs, unlike standard monofilament or braided sutures, are constructed to have small quills evenly dispersed along the length of the suture and thus stay in position once placed, without the need for maintaining or readjusting tension. In addition, no knots need to be tied in order to secure the suture in place. This allows surgeons to complete an intestinal anastomosis in less time and when used during minimally invasive surgery, potentially save the patient one trocar site that would otherwise be used to maintain tension or secure knots.

In spite of the evidence of their potential benefits, BSs have only been used sparingly in children. To date, there are no publications that document the use of BSs in gastrointestinal surgery in children. This report consists of a short series of cases demonstrating that the use of BSs in laparoscopic GI procedures in children is safe.

Methods

We obtained IRB approval and performed a retrospective chart review on four children in whom unidirectional BS, V-Loc 90 (Medtronic, Minneapolis, MN, USA) was used for GI application between January 01, 2013 and December 31, 2014. Variables including patient age and gender, duration of surgery and specific suture used as well as time to feeds post-operative length of stay, post-operative complications were analyzed.

Table 1: Case numbers by procedure.

Case number	Age in days	Laparoscopic Procedure	Number of trocars	Duration of surgery in minutes	Postoperative length of stay in days
1	4455	Gastric tumor excision	4	202	4
2	2	Duodenoduodenostomy	4	174	21
3	2	Duodenoduodenostomy	3	162	14
4	232	Duodenojejunostomy	3	190	9

Results

The first patient was a 12-year-old boy who underwent excision of a gastric leiomyoma followed by repair of the gastrotomy using BS. Two patients were neonates with duodenal atresia. They underwent laparoscopic duodenoduodenostomy at two days of age using BS for the anastomosis. The fourth patient underwent laparoscopic duodenojejunostomy using BS for distal duodenal stenosis at seven months of age. All anastomoses were single-layer and laparoscopically hand-sewn. All procedures were completed without adverse events and without subsequent complications involving the anastomoses (Table 1).

Discussion

Laparoscopic surgery is expected to result in less postoperative pain and shorten hospital stay when compared to open surgery. While surgeons' skills have advanced since the standardization of laparoscopic procedures, some maneuvers still prove to be universally more challenging when performed laparoscopically. BSs have the potential to make anastomosis faster and safer for the patient as well as reproducible among surgeons. Historically, while there are a limited number of publications on intra-abdominal use of BSs in adults, most studies have focused on skin and fascia closure using BSs.

V-loc suture, used in all cases reported in this paper, is made from an absorbable copolymer polyglyconate which has the same degradation properties as a similar synthetic monofilament absorbable suture. The BS is created by etching quills into the polymer in a helical pattern around the strand. The barbs then act as individual anchors in the tissue that grasp the collagen fibers securing the suture in place as it passes through tissue (Figure 1). As the barbs inherently decrease the diameter of the suture, they are sized according to their core diameter 3-0 V-loc suture will have the same tensile strength as a 3-0 Maxon suture. The first two centimeters of the suture lacks barbs as to make it repositionable up to this point. The end is fitted with a loop to secure the first throw. The final throw can be secured without a knot with only a j-loop or a few throws beyond the incision, as the barbs will hold the suture in place. The suture will completely resorb in 180 days; tissue closure strength is approximately 50% at 30 days [2].

BSs not only have the potential to simplify surgical technique and eliminate the risk of knot failure, but may also be an inherently superior design of engineering. While the barb cut into the suture does reduce the core diameter of the suture and thus its tensile strength, in vivo studies in animal of closure of dermal and abdominal wall showed same wound security with BSs as with conventional sutures that are 1 size smaller. Needles of a smaller diameter than the suture itself create tunnel in the tissue through with the barbs can then secure themselves in the surrounding collagen. This thus reduces the need for a tight approximation which may lead to local ischemia and potential wound necrosis [3].

More importantly perhaps, research shows that even in the hands of an experienced laparoscopic surgeon, intracorporeal knots will fail

Figure 1: V-Loc 90 suture.

up to 50% of the time. In 2005, Ritter et al. [4] published a study in which 48 knots of 100 tied by extensively trained minimally invasive surgeons slipped when placed in a tensiometer prior to the suture (2-0 silk) breaking.

As canine and human intestines are similar in size and histology, canine models have been used to test the utility of BSs. Omotosho et al. [5] looked at the use of BS in 24 dogs to close enterotomies in the stomach, jejunum and colon. Three enterotomies were made and each closed with monofilament, absorbable BS and nonabsorbable suture respectively in a single-layer simple running fashion. The closures were then tested at day 3, 10 and 21 to evaluate for leak and burst pressure. No significant difference was found between the control and BS groups for leak rates, overall 0%, but the enterotomies were able to be sutured closed 35% to 42% faster [5].

Ehrhart et al. [6] also tested BSs in the canine model 14 dogs underwent laparoscopic gastrotomies and enterotomies of the jejunum and colon. Similar to the aforementioned study, the defects were closed with both monofilament with three square knots at each end, and 3-0 V-loc BSs then burst pressures were tested at day 3, 7 and 14. Again, there was no significant difference in the leak rate between monofilament but the closure rate with BSs was again significantly more efficient [6].

Two studies by Tyner et al. [7] and Lee et al. [2] have evaluated BS anastomosis in human models. Tyner studied 84 morbidly obese patients who underwent laparoscopic gastric bypass surgery with a hand-sewn gastrojejunostomy anastomosis and hand-sewn closure of the common enterotomy of the jejunojejunosomty. In all, 84 cases were studied, 46 of which were with 3-0 V-Loc 180 BS and 38 with traditional 3-0 PDS. As with the animal models, there was no significant difference in overall complication rate (no incidences of anastomotic leak or stenosis for each group). In addition the cases with BS were completed on average 23 minutes faster [7].

Lee et al. [2] studied the use of BSs in laparoscopic gastrectomy for tumor resection in which staple anastomosis entry holes were closed using knotless unidirectional BS in a continuous two-layer fashion. Two hundred forty two patients underwent a total of 256 intracorporeal anastomoses all with the use of the 3-0 V-Loc suture. The researchers determined that though this was a novel technique for most of the surgeons in the study, all mastered the suture by 6 cases. At the conclusion of this study, there were no deaths and no incidence of anastomotic leak, bleeding or stricture. In conclusion, the researchers determined that intracorporeal suturing is a safe

practice in gastric surgery though further research still needs to be conducted [2].

In our study population, though small, we too had no complications when using BSs.

Conclusion

The authors of this study conclude that the use of V-Loc absorbable unidirectional BSs in laparoscopic gastrointestinal anastomosis is feasible and safe in children including neonates. In addition, their use may be superior to that of traditional suture; at the minimum, BS can reduce operative time with no adverse consequences, though further investigation is needed in this population.

References

1. Ruff GL. The history of barbed sutures. Aesthet Surg J. 2013; 33: 12S-16S.
2. Lee S, Kawai M, Tashiro K, Nomura E, Tokuhara T, Kawashima S, et al. Laparoscopic gastrointestinal anastomoses using knotless barbed absorbable sutures are safe and reproducible: a single-center experience with 242 patients. Jpn J Clin Oncol. 2016: 46: 329-325.
3. Paul MD. Bidirectional barbed sutures for wound closure: evolution and applications. J Am Col Certif Wound Spec. 2009; 1: 51-57.
4. Ritter E, McClusky D, Gallagher A, Smith C. Real-time objective assessment of knot quality with a portable tensionmeter is superior to execution time for assessment of laparoscopic knot-tying performance. Surg Innov. 2005; 12: 233-237.
5. Omotosho P, Yurcisin B, Ceppa E, Miller J, Kirsch D, Portenier D. In vivo assessment of an absorbable and nonabsorbable knotless BS for laparoscopic single-layer enterotomy closure: a clinical and biomechanical comparison against nonBS. J laparoendosc Adv Surg Tech A. 2011; 21: 893-897.
6. Ehrhart NP, Kaminskaya K, Miller JA, Zaruby JF. In vivo assessment of absorbable knotless barbed suture for single layer gastrotomy and enterotomy closure. Vet Surg. 2013; 42: 210-216.
7. Tyner, RP, Clifton GT, Fenton SJ. Hand-sewn gastrojejunostomy using knotless unidirectional barbed absorbable suture during laparoscopic gastric bypass. Surg Endosc. 2013; 27: 1360-1366.