Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/qt0efh83

A COMPARATIVE STUDY ANALYSING UNIDIRECTIONAL BARBED SUTURE VS. CONVENTIONAL SUTURE IN THE CLOSURE OF ANTERIOR ABDOMINAL WALL

Dr. Ahmed Inayath Syed[1*], Dr. Ikram Fareed F.[2], Dr. Sachin[3], Dr. Narayana. V.[4], Dr. Puja Kumari[5]

[1]Postgraduate, Department of General Surgery, Vydehi Institute of Medical Sciences, Bangalore, Karnataka, India.
[2]Assistant Professor, Department of General Surgery, Vydehi Institute of Medical Sciences, Bangalore, Karnataka, India.
[3]Assistant Professor, Department of General Surgery, Vydehi Institute of Medical Sciences, Bangalore, Karnataka, India.
[4]Professor, Department of General Surgery, Vydehi Institute of Medical Sciences, Bangalore, Karnataka, India.
[5]Postgraduate, Department of General Surgery, Vydehi Institute of Medical Sciences, Bangalore, Karnataka, India.

***Corresponding Author:** Dr. Ahmed Inayath Syed
*Postgraduate, Department of General Surgery, Vydehi Institute of Medical Sciences, Bangalore, Karnataka, India.

ABSTRACT

Background: Barbed sutures revolutionize abdominal wall closure by eliminating knots, evenly distributing tension, reducing closure time, and lowering postoperative pain, complications, and incisional hernia rates. Their self-locking mechanism enhances stability and wound healing outcomes, making them a preferred choice in modern surgical practice. Studies consistently show superior patient comfort, quicker recovery, and higher satisfaction with barbed sutures, marking a significant advancement in surgical closure techniques.

Methods: This was a comparative study of 126 patients undergoing laparotomy in the Department of General Surgery, Vydehi Institute of Medical Sciences and Research Centre, Bangalore, with abdominal closure either with barbed PDS sutures or conventional loop suture in case (63 patients) and control (63 patients).

Results: There was no difference in demographic and preoperative profiles in both groups. The study showed a reduction in the incidence of both hernia at 1 year, surgical site infections, and pain throughout the course of the hospital. Statistical significance was found with respect to the incidence of hernia as well as the reduction of postoperative pain in the barbed suture group when compared to the loop suture group.

Conclusion: Barbed sutures offer benefits in terms of efficiency, reduced pain, and lower complication rates, making them a favourable choice for anterior abdominal wall closures.

Key Words: Barbed Sutures, Abdominal Wall Closure.

INTRODUCTION

Surgical closure techniques are crucial for wound healing and postoperative recovery. Traditional suturing methods have evolved from simple stitches to sophisticated materials and methods designed to reduce complications and enhance healing.[1] However, issues such as suture tension, knot security, and tissue trauma remain significant concerns.[2] Effective closure of the abdominal wall is essential to prevent postoperative complications such as hernias, infections, and wound dehiscence. The strength and integrity of the abdominal closure are critical for patient recovery and long-term outcomes.[3]

The introduction of barbed sutures marked a significant milestone in surgical techniques. These sutures are designed with barbs along their length, eliminating the need for knots and distributing tension more evenly across the wound.[3] This innovation aims to address the limitations of conventional sutures, which often concentrate tension at the knots, leading to potential tissue damage and compromised healing. The self-locking mechanism of barbed sutures enhances knot security and reduces the risk of slippage, thereby improving the overall stability of the wound.[4]

The even distribution of tension along the suture line facilitates better perfusion of the wound edges, promoting more effective healing and reducing the incidence of complications such as erythema, discharge, and local rise in temperature.[5] Additionally, the reduced need for knots means there are fewer focal points of tension that could lead to tissue necrosis or dehiscence, further enhancing the healing process.

One of the advantages of barbed sutures is their ability to reduce closure time significantly.[6] This reduction in operative time is particularly beneficial in high-volume surgical settings and emergency procedures where time is of the essence. Postoperative pain is another critical factor in evaluating the effectiveness of suturing techniques. This study was carried out to assess the effectiveness of barbed sutures for the closure of the anterior abdominal wall.

MATERIALS & METHODS

This was a prospective observational study carried out over a period of 18 months involving 126 patients aged > 18 years undergoing elective and emergency open abdominal surgeries. Patients having previous reactions to synthetic suture materials, immunosuppressed, those on steroid medications, BMI > 35, history of keloid/hypertrophic scar, or any concomitant dermatological conditions that may impair wound healing, chronic alcoholism/drug abuse/smoking, and those belonging to ASA class 3 & 4 were excluded from the study. Intraoperatively, the time taken for abdominal wall closures was assessed. Postoperatively, all patients were assessed for pain on POD1, POD3, POD5, and at discharge. A visual analogue scale was used for the assessment of postoperative pain. Regular dressings and surgical site examination were carried out on POD3, POD5, POD7, and at the time of discharge. The surgical site was objectively assessed for signs of wound healing. Antibiotics were administered based on whether the surgery was clean, clean contaminated, contaminated, or dirty. Patients were assessed for wound dehiscence or evisceration, if any, at the 1-month follow-up based on clinical examination, followed by, if needed, radiological examination by means of ultrasonography. Further assessment for the presence of an incisional hernia was carried out at 3 months, 6 months, and 1 year follow-up based on clinical examination and, if needed, further radiological examination by means of ultrasonography.

Statistical Analysis

Data was entered into the Microsoft Excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. The chi-square test or Fischer's exact test (for 2x2 tables only) was used as a test of significance for qualitative data. Continuous data was represented as mean and standard deviation. An independent t-test was used as a test of significance to identify the mean difference between two quantitative variables. P-value (probability that the result is true) of <0.05 was considered statistically significant.

RESULTS

There was no statistically significant difference found between the two groups with respect to age (P=0.985).126 participants of the study with a minimum age of 22 years and a maximum age of 76 years were randomly distributed throughout the study.

	Mean	**Std. Deviation**	**P-Value**
Group L	48.69	9.757	0.985
Group B	48.73	9.867	
Table 1: Distribution of Subjects According to Age			

The male and female sex ratios were comparable for the study. With a p-value of 0.473, there was no statistically significant difference found between groups with respect to sex distribution.
There was no statistically significant difference found between groups with respect to type of surgery (p-value 0.547).

	Group B		**Group L**	
	N	**%**	**N**	**%**
Contaminated	3	4.8%	1	1.6%
Clean Contaminated	9	14.3%	11	17.5%
Clean	51	81.0%	51	81.0%
Table 2: Distribution of Subjects According to Type of Surgery among the Group				

The presence of incisional hernia diagnosed at the end of 1 year was less in the barbed group than the loop group and was found to be statistically significant, p-value 0.015.

	Group B		**Group L**	
	N	**%**	**N**	**%**
No	61	96.8%	53	84.1%
Yes	2	3.2%	10	15.9%
Table 3: Distribution of Subjects According to Hernia among the Group				

No hernia was found to occur at 3 months with lesser incidence of incisional hernia at 6 and 12 months in the barbed group in comparison to the loop group. All hernias were identified clinically with a presence of cough impulse or on ultrasonography. There was statistical significance in the lesser occurrence of hernia in the barbed group at the end of the 12-month follow-up.

	Group B		**Group L**		**P-Value**
	N	**%**	**N**	**%**	
3 Months	0	0%	0	0%	--
6 Months	1	1.5%	4	6.3%	0.420
12 Months	1	1.5%	6	9.5%	0.049
Table 4: Distribution of Subjects According to Hernia among the Group at Various Time Period					

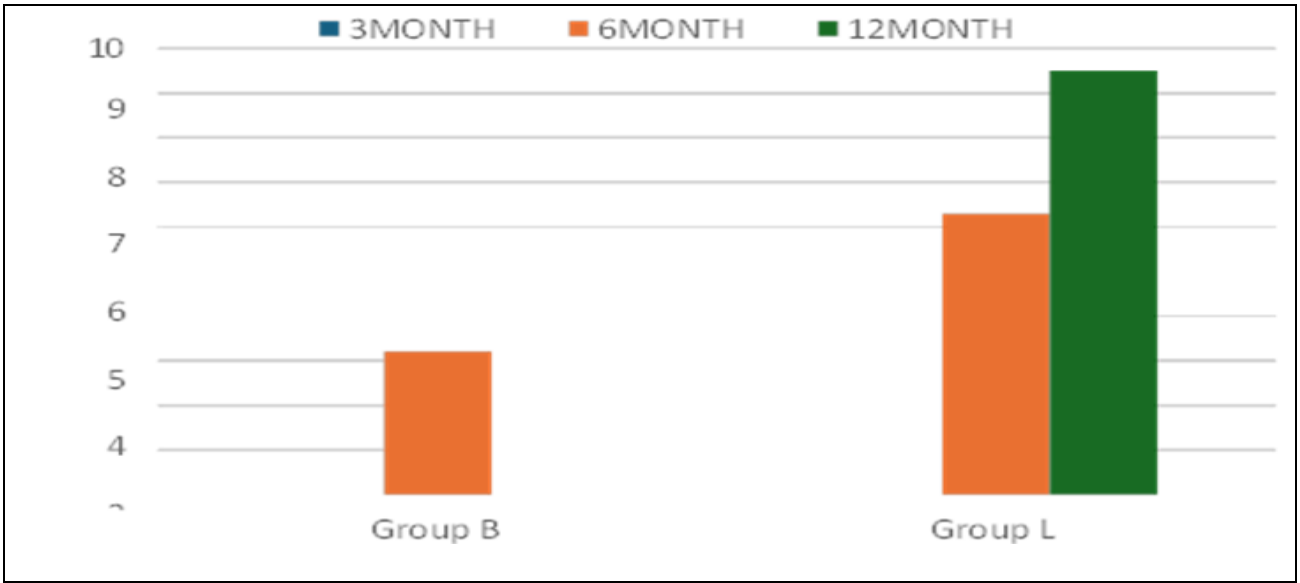

Figure 1: Distribution of Subjects According to Hernia among the Group at Various Time Period

There was no statistically significant difference found between groups with respect to SSI, p-value = 0.763

	Group B		**Group L**	
	N	**%**	**N**	**%**
No	58	92.1%	56	88.9%
Yes	5	7.9%	7	11.1%

Table 5: Distribution of Subjects According to SSI among the Group

Pain on POD1, 3, and 5 was found to be lower in the barbed suture group than the loop suture group, though there was no statistical significance, p-values 0.345, 0.228, and 0.034, respectively. More individuals were pain-free in the barbed group in comparison to the loop group at the time of discharge. P-value 0.045; there was a statistically significant difference found between groups with respect to pain on discharge.

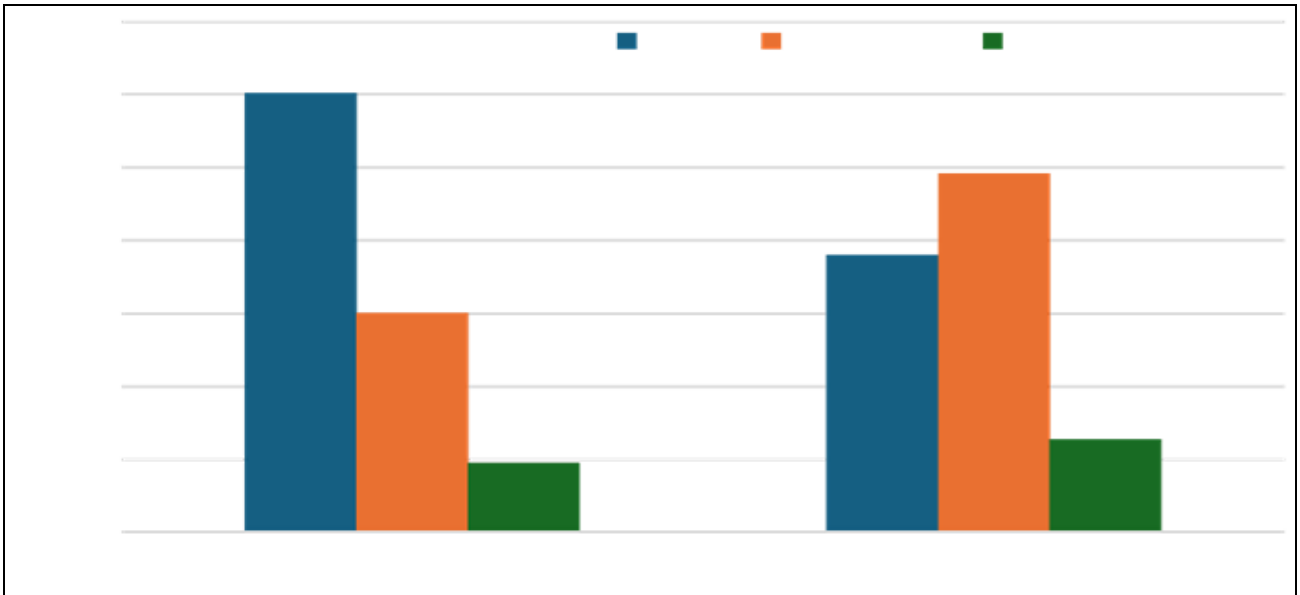

Figure 2: Distribution of Subjects According to Pain on Discharge among the Group

The defect size was found to be persistently smaller in the barbed group than the loop group on ultrasonographic interrogation, though the study showed no statistical significance (p = 0.099).

	Mean	**Std. Deviation**	**P-Value**
Group L	2.65	4.457	0.099
Group B	1.50	3.320	
Table 6: Comparison of Mean Defect Size between Two Groups			

DISCUSSION

The majority of the operations performed by a general surgeon take place on the abdomen, and consequently, the incision and suturing of abdominal parietes is one of the commonest exercises in operative surgery. A considerable number of different suturing techniques exist for closure, and each has its pros and cons.[7]

The surgical approach for abdominal wall closure has the potential to prevent complications and reduce resource utilization associated with healthcare services.[8] Currently, there is a lack of consensus regarding the best suturing technique and material to use in open abdominal wall closure to prevent postoperative complications.[9] Surgeons are faced with a vast choice of materials due to the rapidly growing market for medical devices.[10] As shown by a recent network meta-analysis of 31 trials, while no suture material could be identified as optimal.[11]

126 patients undergoing laparotomy were included in this study. 63 cases out of these were closed by loop suture material, and 63 cases were closed by barbed sutures. Age and sex distribution were similar in both groups and hence comparable.

Incisional hernias can result from inadequate wound closure and increased intra-abdominal pressure, leading to the protrusion of abdominal contents through the surgical site. In our study, the presence of incisional hernia diagnosed at the end of 1 year was less in the barbed group than the loop group and was found to be statistically significant. No hernia was found to occur at 3 months, with a lesser incidence of incisional hernia at 6 and 12 months in the barbed group in comparison to the loop group. This is in line with more recent studies carried out in the world of surgery with regard to the efficacy of barbed sutures in the closure of the anterior abdominal wall.

Not only was the incidence of occurrence of hernia lower in the barbed group, but also the size of the defect was lower in the barbed group than in the loop group, though there was no statistical significance. These findings indicate that barbed sutures contribute to better wound healing and reduce the risk of complications, consistent with the homogeneous distribution of tension along the suture line, which improves perfusion and healing.[5] One of the primary advantages of barbed sutures is their unique design, which allows for an even distribution of tension across the wound. This even tension distribution is crucial for minimizing localized pressure points that can lead to tissue strangulation and necrosis.

Surgical site infections were defined according to the standard criteria devised by the CDC. SSI includes superficial and deep incisional SSI that develops during the first 30 days after surgery. In our study, though the incidence of surgical site infections was lower in the barbed group than the loop group, there was no statistical significance because of the marginal reduction of occurrence of surgical site infections in the barbed group. Surgical site discharge can indicate infection or poor wound healing, both of which are serious concerns in postoperative care. The self-locking mechanism of barbed sutures reduces the likelihood of wound dehiscence, which is a common cause of discharge. By maintaining a secure and stable wound closure, barbed sutures help to prevent gaps in the wound that can become sites for bacterial colonization and infection.

There was statistically significant pain reduction in the barbed suture group on assessment at POD5 and at discharge of the patient in comparison to the loop group. Lower postoperative pain levels have been consistently reported in patients with barbed sutures compared to those with conventional sutures. The mechanism by which barbed sutures achieve this reduction in postoperative pain is multifaceted. This is likely due to the elimination of knots, which can cause localized irritation and

discomfort. By distributing tension evenly and minimizing mechanical irritation, barbed sutures enhance patient comfort during the recovery period. Lower pain levels not only improve patient satisfaction but also facilitate quicker mobilization and adherence to postoperative care protocols, which are essential for a successful recovery.[12]

The even distribution of tension and elimination of knots reduce mechanical irritation and promote better tissue integration and healing. This results in a more stable and less inflamed surgical site, which is crucial for preventing infections and other complications. A study by Ferrer-Márquez and Belda-Lozano[13] found that barbed sutures were associated with lower rates of postoperative complications compared to conventional sutures. Their research supports the notion that the homogeneous distribution of tension along the suture line improves perfusion and healing, reducing the risk of complications such as erythema, discharge, and wound dehiscence. Similarly, Ruiz-Tovar et al.[5] reported that barbed sutures resulted in fewer surgical site infections and better overall wound healing outcomes. The positive impact of barbed sutures on pain management is supported by previous studies. Weissner et al.,[14] observed that barbed sutures were associated with reduced postoperative pain and inflammation, corroborating the findings of this study.

In a study carried out by Berrevoet et al.,[15] at 30-day follow-up, clinical outcomes were not significantly different between the barbed and conventional PDS groups for wound dehiscence, SSIs, and perioperative complications. However, the relative frequency of SSIs at the 60- and 90-day follow-up was significantly greater in the conventional PDS group (60 days, 11.4% vs. 5.9%; $P = 0.0083$; 90 days, 11.7% vs. 5.9%; $P = 0.0060$). Overall perioperative complications occurred more frequently in conventional PDS patients both at 60-day (12.5% vs. 7.0%; $P = 0.0122$) and 90-day follow-up (12.7% vs. 7.0%; $P = 0.0090$). Among patients developing SSIs, deep SSIs at 60- and 90-day follow-up were also significantly more frequent in the conventional PDS group (60 days, 15/42 vs. 2/22, 35.7% vs. 9.1%; $P = 0.022$; 90 days, 15/43 vs. 2/22, 34.9% vs. 9.1%; $P = 0.0252$).

Multivariate analyses showed that at 30, 60, and 90 days, there was no significant association between the type of suture used and wound dehiscence outcome when adjusted for confounders. At 30-, 60- and 90-day follow-up, barbed patients were nearly half as likely to experience SSIs. The likelihood of any perioperative complication was non-significant for suture type at 30 days, but at 60- and 90-day follow-up, barbed patients were nearly half as likely to experience perioperative complications as compared to conventional PDS suture.

There is a lack of consensus regarding the best surgical approach to use in abdominal wall closure to prevent complications.[16] Given the vast choice of suturing materials available on the market, evidence is based on studies with relatively small sample sizes and variable postoperative follow-up. A recent network meta-analysis of 31 trials, including data on 11,533 patients undergoing abdominal wall repair, used pairwise comparisons of suture materials for assessment of clinical outcomes.[17] The results revealed that no suture material outperformed the rest in terms of prevention of SSI, midline incisional hernia, wound dehiscence, or sinus/fistula occurrence.

In the study by Ferrer-Márquez et al., patients in the barbed suture group reported consistently lower pain scores on postoperative days 1, 3, 5, and at discharge compared to those in the conventional suture group.[2] Lower postoperative pain levels not only improve patient comfort but also facilitate quicker mobilization and recovery, thereby reducing hospital stay duration and improving overall patient satisfaction. Clinical implications of these findings are significant.

The use of barbed sutures in abdominal surgeries, both elective and emergency, is recommended due to their efficiency and efficacy in reducing closure time, minimizing complications, and improving patient comfort. The incidence of long-term complications, such as incisional hernias, is also lower with the use of barbed sutures. Follow-up assessments conducted at 1 month, 3 months, 6 months, and 1 year have shown a consistently lower incidence of incisional hernias in patients with barbed sutures.[12] This is likely due to the enhanced stability and integrity provided by the self-anchoring mechanism of the barbed sutures, which maintains wound closure even if there is a partial tear at any point along the suture line.[18]

CONCLUSION

The present study reaffirmed the superiority of unidirectional self locking, even tension providing barbed sutures over loop sutures with respect to the incidence of incisional hernia and post-operative pain in laparotomy patients.

REFERENCES

[1] Chu CC, von Fraunhofer JA, Greisler HP. Wound Closure Biomaterials and Devices. Boca Raton, FL: CRC Press 1997.
[2] Ferrer-Márquez M, Belda-Lozano R. Barbed sutures in general and digestive surgery. Review Cir Esp (Engl Ed) 2016;94(2):65-9.
[3] Nawrocki JG, Nonnenmann H, Mooney M, Sutton N, Schmitz ND. A high- strength, absorbable, antibacterial knotless tissue control device for fascial closure. Curr Obstet Gynecol Rep 2017;6(2):175-81.
[4] Matarasso A, Paul M. Barbed sutures in aesthetic plastic surgery: evolution of thought and process. Aesthetic Surgery Journal 2013;33(3 Suppl):17S-31.
[5] Ruiz-Tovar J, Llavero C, Jimenez-Fuertes M, Duran M, Perez-Lopez M, Garcia-Marin A. Incisional surgical site infection after abdominal fascial closure with triclosan-coated barbed suture vs triclosan-coated polydioxanone loop suture vs polydioxanone loop suture in emergent abdominal surgery: a randomized clinical trial. Journal of the American College of Surgeons 2020;230(5):766-74.
[6] Kim D, Park J, Joo J, Jeon J, Lim S. The overlapping running suture method using single knotless barbed absorbable suture material for abdominal wall closure after single incision laparoscopic appendectomy: comparison with the traditional interrupted closure technique. The Journal of Minimally Invasive Surgery 2018;21(4):160-7.
[7] Hugh TB, Nankivell C, Meagher AP. Is closure of peritoneal layer necessary in the repair of midline surgical abdominal wounds? World J Surg 1990;14:231-4.
[8] Muysoms FE, Antoniou SA, Bury K, Campanelli G, Conze J, Cuccurullo D, et al. European Hernia Society guidelines on the closure of abdominal wall incisions. Hernia 2015;19:1–24.
[9] Hempel S, Kalauch A, Oehme F, Wolk S, Welsch T, Weitz J, et al. Wound complications after primary and repeated midline, transverse and modified Makuuchi incision: a single-center experience in 696 patients. Medicine 2021;100(20):e25989.
[10] Muysoms F, Campanelli G, Champault GG, DeBeaux AC, Dietz UA, Jeekel J, et al. EuraHS: the development of an international online platform for registration and outcome measurement of ventral abdominal wall hernia repair. Hernia 2012;16:239-50.
[11] Zucker BE, Simillis C, Tekkis P, Kontovounisios C. Suture choice to reduce occurrence of surgical site infection, hernia, wound dehiscence and sinus/fistula: a network meta-analysis. Ann R Coll Surg Engl 2019;101:150-61.
[12] Talwar P, Velayudam L, Hemapriya L, Patil S. Barbed suture in total laparoscopic hysterectomy: a comparative study of the safety in vaginal cuff closure with that of polyglactin 910 suture. Gynecol Minim Invasive Ther 2021;10:154-8.
[13] Zucker BE, Simillis C, Tekkis P, Kontovounisios C. Suture choice to reduce occurrence of surgical site infection, hernia, wound dehiscence and sinus/fistula: a network meta-analysis. Ann R Coll Surg Engl 2019;101:150-61.
[14] Wiessner R, Vorwerk T, Tolla-Jensen C, Gehring A. Continuous laparoscopic closure of the linea alba with barbed sutures combined with laparoscopic mesh implantation (IPOM Plus Repair) as a new technique for treatment of abdominal hernias. Front Surg 2017;4:62.
[15] Berrevoet F, van Cauteren L, Gunja N, Danker WA, Schmitz ND, Tomaszewski J, et al. Clinical outcomes of triclosan-coated barbed suture in open hernia repair: a retrospective cohort study. Hernia 2024;28(4):1239-47.

[16] Hempel S, Kalauch A, Oehme F, Wolk S, Welsch T, Weitz J, et al. Wound complications after primary and repeated midline, transverse and modified Makuuchi incision: A single-center experience in 696 patients. Medicine 2021;100(20):e25989.
[17] Zucker BE, Simillis C, Tekkis P, Kontovounisios C. Suture choice to reduce occurrence of surgical site infection, hernia, wound dehiscence and sinus/fistula: a network meta-analysis. Ann R Coll Surg Engl 2019;101:150-61.
[18] Montorfano L, Szomstein S, Valera RJ, Bordes SJ, Cobos MS, Quirante FP, et al. Non-absorbable barbed sutures for primary fascial closure in laparoscopic ventral hernia repair. Cureus 2022;14(2):e22523.