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COMPARISON OF ABSORBABLE EXTRA LONG TERM POLY HYDROXY BUTYRATE SUTURE VS NON ABSORBABLE (POLYPROPYLENE) SUTURE FOR ABDOMINAL WALL CLOSURE

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ABSTRACT: PURPOSE: The aim of study is to compare Continuous technique with non-absorbable sutures, Interrupted technique with non-absorbable sutures and Continuous technique with slowly absorbable sutures Focusing mainly on incidence of incisional hernias, burst abdomen, wound infections, chronic wound pain, suture sinus, stitch granuloma, time for rectus closure. **METHODOLOGY:** Study was conducted for a period of one year on 271 randomized patients with primary elective midline laparotomy in our hospital. patients are divided into group I includes 102 patients with continuous technique using non absorbable polypropylene, group II includes 91 patients with interrupted technique using non absorbable polypropylene and group III includes 78 patients with continuous slowly absorbable polyhydroxybutyrate. **RESULTS:** No significant difference observed in incidence of wound infections and burst abdomen in all the 3 groups but relatively higher incidence of wound infections in noted our hospital. Incidence of stich granuloma suture sinus and chronic wound pain is more with interrupted technique than continuous technique and are more with non-absorbable suture material. **CONCLUSION:** Incidence of incisional hernias, suture complications like suture sinus, stitch granuloma can be more effectively reduced with slowly absorbable continuous sutures.

KEYWORDS: Non-absorbable polypropylene, Absorbable polyhydroxybutyrate, Laparotomy.

INTRODUCTION: In patients undergoing midline incisions, rectus sheath can be closed with continuous or interrupted suture using absorbable or non-absorbable materials. Despite major improvements in antibiotics, better anesthesia, superior instruments, earlier diagnosis of surgical problems, and improved techniques for postoperative vigilance, post-operative complications like incisional hernias, burst abdomen, wound infections continue to occur, which causes significant surgical health care problem. The rate of incisional hernias 1 year postoperatively is estimated to be 9–20%,^(1–4) the frequency of reoperation due to burst abdomen 1–3%^(5–8) and the rate of wound infections 3–19%.^(9–12) The optimal technique and suture material for abdominal wall closure have, therefore, long been a matter of debate.^(13–19)

Decrease of the post-operative surgical complications can reduce the length of hospital stay, significant morbidity and even mortality and financial burden to the health care system.

In response to the requirements of modern surgery and thanks to the efforts of users and manufacturers over the last few decades, a wide variety of sutures have now been developed.²⁰ Routinely non-absorbable polypropylene is used for the closure of rectus sheath in midline laparotomy, which remains as a foreign material throughout the life after wound gains tensile strength. Several studied were conducted previously using absorbable materials for the rectus

ORIGINAL ARTICLE

closure, with negative results. But recently, studies in other countries showed that slowly absorbable suture materials can reduce the challenges of abdominal wall closure, which was least explored in our country.

The aim of study is to compare Continuous technique with non-absorbable sutures (polypropylene) in group I, Interrupted technique with non-absorbable suture (polypropylene) in group II Continuous technique with slowly absorbable sutures (polyhydroxybutyrate) in group III, of rectus sheath closure. Focusing mainly on incidence of incisional hernias, burst abdomen, wound infections, chronic wound pain, suture sinus, stitch granuloma, time for rectus closure.

METHODOLOGY: It is Randomized controlled, prospective study on 271 patients with primary elective midline laparotomy in our hospital. Patients operated from October 2013 to October 2014 are included in this study and are followed up for a minimum period of one year.

INCLUSION CRITERIA: Age in between 18-70 years Patients undergoing elective primary midline laparotomy, expected length of incision of at least 10 cms and Life expectancy more than one and half year.

EXCLUSION CRITERIA: Patients requiring emergency surgery, Patients undergoing immunosuppressive therapy, Patients undergoing chemotherapy within two weeks before surgery, Patients undergoing radiotherapy longer than 8 weeks before surgery, patients with coagulopathy.

Controls are considered of patients in whom the abdominal fascia closed with polypropylene are included in control group. Thus this study contains two control groups i.e. group I (Continuous polypropylene) and group II (Interrupted polypropylene). Cases are patients in whom the abdominal fascia closed with polyhydroxy butyrate are included in cases group i.e. group III (Continuous polyhydroxy butyrate). The results of this study obtained by comparing group I and group III, group II and group III separately.

Randomization of surgical technique:

- 1) In all patients, the skin cut with scalpel and fascia was cut with cautery.
- 2) The patients were randomized intra operatively to the 3 facial closure groups.
- 3) No extra peritoneal sutures are allowed.
- 4) In all three groups, fascial closure started from cranial end and proceeded towards caudal end.
- 5) The first V shaped stitch was placed at the edges outside the fascial incision and second stitch at a 1.5cm distance. The stitches were spaced at the same distance apart from the fascial incision on both sides laterally.
- 6) In continuous suturing, knot was buried at the caudal end.
- 7) A 4:1 ratio (Suture: fascial incision length) was required for continuous groups.
- 8) No subcutaneous sutures or drainage was inserted. The skin being closed with cutting silk in all the groups.

Either healing of the wound by primary intention or by secondary intention, reoperation due to burst abdomen or wound infection until the day of discharge were noted. Study efficacy,

ORIGINAL ARTICLE

were the frequency of abdominal hernias at minimum follow up of 1 year. Results were analysed for Significance levels are written as a decimal (such as 0.01), which corresponds to the percent chance that the experimental results happened by chance (in this case, 1%).

RESULTS: Study was conducted for a period of one year on 271 randomized patients in our hospital.

- 1) Group I includes 102 patients with continuous technique using non-absorbable polypropylene,
- 2) Group II includes 91 patients with interrupted technique using non-absorbable polypropylene,
- 3) Group III includes 78 patients with continuous slowly absorbable polyhydroxybutyrate.

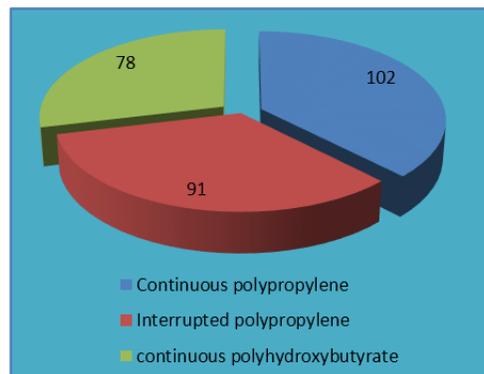


Fig. 1: Number of patients in the groups

Type of Sutures	Incidence of wound infection	Percentage of wound infection (%)	Incidence of incisional hernia	Percentage of incisional hernia (%)
Continuous non-absorbable polypropylene (n=102)	15	14.70%	13	12.74%
Interrupted non-absorbable polypropylene (n=91)	14	15.38%	12	13.18%
Continuous slowly absorbable polyhydroxybutyrate (n=78)	12	16.66%	5	6.41%

Table 1: Incidence of wound infection and incisional hernia

Type of Sutures	Incidence of burst abdomen	Percentage of burst abdomen (%)	Incidence of stitch granuloma	Percentage of stitch granuloma (%)
Continuous non-absorbable polypropylene (n=102)	4	3.92%	5	4.90 %
Interrupted non-absorbable polypropylene (n=91)	3	3.29 %	8	8.79 %

ORIGINAL ARTICLE

Continuous slowly absorbable polyhydroxybutyrate(n=78)	3	3.84 %	2	2.56 %
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Table 2: Incidence of burst abdomen and stitch granuloma

Type of Sutures	Incidence of suture sinus	Percentage of suture sinus (%)	Incidence of chronic wound pain	Percentage of chronic wound pain (%)
Continuous non-absorbable polypropylene (n=102)	2	1.96 %	5	4.90 %
Interrupted non-absorbable polypropylene (n=91)	5	5.49 %	10	10.9 %
Continuous slowly absorbable polyhydroxybutyrate (n=78)	1	1.28 %	2	2.56 %

Table 3: Incidence of suture sinus and chronic wound pain

Type of Sutures	Average time for rectus closure for 10cm mid line incision(min)
Continuous non-absorbable polypropylene (n=102)	9.20
Interrupted non-absorbable polypropylene (n=91)	16.5
Continuous slowly absorbable polyhydroxybutyrate (n=78)	9.4

Table 4: Average time for rectus closure

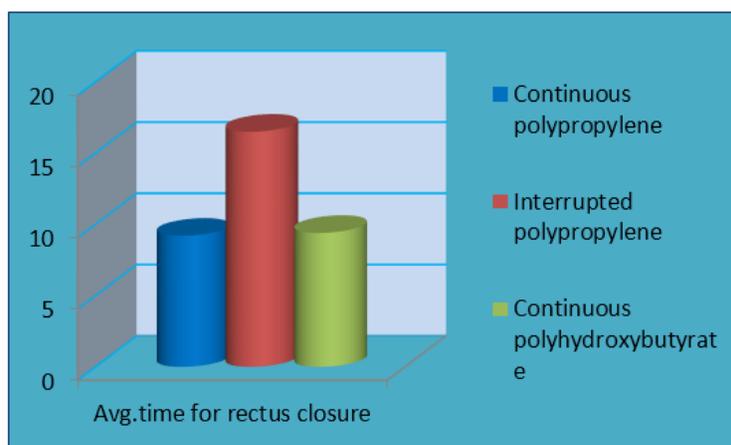


Fig. 2: Average time for rectus closure

ORIGINAL ARTICLE



Fig. 3: Complications in the present study after surgery

DISCUSSION: The results of polyhydroxybutyrate compared with continuous polypropylene and interrupted polypropylene are analysed. Incidence of surgical site infection in group I, group II and group III in this study are 14.70%, 15.38% and 16.66% respectively. Study shows that there is no significant difference in incidence of surgical site infection with polyhydroxybutyrate when compared with continuous polypropylene and interrupted polypropylene also. (Table 1 and 2)

Various Studies	Wound Infections	Incisional Hernia	Incisional Burst Abdomen
Trimbos et al²¹ (n=340)			
Continuous maxon	3.6%	3.0 %	3.0 %
Interrupted vicryl	1.2%	4.1 %	4.1 %
Seiler et al²² (n=625)			
Continuous monoplus	15.7%	12.5 %	1.9%
Continuous PDS	19%	8.4 %	2.9 %
Interrupted vicryl	12.3%	14.2 %	3.8 %
Corman et al²³ (n=161)			
Interrupted vicryl	10.2%	3.8 %	3.8 %
Interrupted prolene	9.4%	8.2 %	8.2 %

ORIGINAL ARTICLE

Colombo et al²⁴ (n=732)			
Continuous maxon	1.0%	8.8 %	0.3 %
Interrupted dexion	1.6%	13.4 %	1.3 %
Hsiao et al¹⁹ (n=340)			
Continuous vicryl –	7.3%	7.3%	2.0 %
Continuous PDS -	7.0%	3.4%	0.5 %
Richards et al²⁵ (n=571)			
Continuous prolene	5.0%	2.0 %	0.3 %
Interrupted dexion	7.0%	0.5 %	0.3 %
Krukowski et al²⁶ (n=757)			
Continuous PDS	3.5%	3.5 %	2.2 %
Continuous prolene	7.0%	4.7 %	1.0 %
Wissing et al¹⁷ (n=1491)			1.6 %
Continuous vicryl	9.0%	20.7 %	3.5 %
ContinuousPDS –	11.6%	13.2 %	2.1 %
Continuous nylon	- 7.2%	10.4 %	2.2 %
Interrupted vicryl -	6.6%	16.8 %	
Lewis and wiegand (n=200)			
Continuous prolene	10.4%	2.2 %	2.7%
Interrupted dexion	10.7%	1.0 %	0 %
Carlson and condon (n=225)			
Continuous nylon	3.6%	4.4%	0.5 %
Continuous maxon	1.8%	8.8%	0.7 %
Israelson and jonsson⁹ (n=817)			
Continuous PDS	9.4%	15.1 %	
Continuous nylon	8.6%	15.7 %	

Table 5: Comparison of Incidence of with various sutures

Various previous studies from the above table shows that incidence of wound infections does not vary with the suture material used for fascial closure. Wide range of variation of wound infection rates in various Centres shows that incidence of wound infections is centre dependent. Most of the surgeries included in this study are clean and clean contaminated wounds, expected incidence of wound infection is less than 10% (Clean–1 to 3%, clean contaminated 5 to 8%). Reaching 17%, the rate of wound infection in our hospital was much higher the antibiotic prophylaxis in today's surgical practice would lead to expect. Indeed, almost all patients received antibiotic prophylaxis and most of them suffered an opening of gastrointestinal tract during the operation. A possible explanation for the high incidence may be due to poor hygienic condition of the patient and surroundings in our government hospital.

Incidence of incisional hernia in group I, group II and group III in this study are 12.74%, 13.18% and 6.41% respectively. Study shows that there is significant difference in incidence of incisional hernia with polyhydroxybutyrate when compared with continuous polypropylene and interrupted polypropylene.

ORIGINAL ARTICLE

Most important etiological factor for incisional hernia is wound infections. As there is no significant difference in wound infection rate and surgical technique is also randomized in this study, decrease in incidence of hernias signifies the importance of suture material. Possible explanation for the decrease in incidence of incisional hernias with polyhydroxybutyrate may be the elasticity property of material which does not interfere with respiratory abdominal movements postoperatively.

Besides surgical technique and suture material, numerous additional factors are believed to play a role in hernia formation including obesity, diabetes, malignancy. These factors were not analysed. Hernias in relation to specific surgery were also not analysed in this study.

Moreover the pathophysiology of wound healing has to be considered as a major unknown variable of hernia formation. Collagen malformation in particular was linked to hernia formation in both clinical and biochemical studies. Within this context matrix metalloproteinases, which regulate the components of the extracellular matrix, play an important role in scarring process. Likewise, Klinge et al⁽²⁷⁾ found reduced matrix metalloproteinases expression patterns in patients with incisional hernias. Moreover, smoking was related to increased collagenolysis and inappropriate repair. Genetic influences and the corresponding molecular mechanisms have to be explored in the future since various connective tissue disorders are known to be heritable or caused by genetic mutation (eg. Homocystinuria, Marfan's, Ehlers – Danlos syndrome).

Thus multimodal concept of optimizing the surgical technique, the suture material, and wound healing are believed capable of reducing incisional hernia sufficiently.

Incidence of burst abdomen in group I, group II and group III in this study are 3.92%, 3.29%, and 3.84% respectively. Null hypothesis I is accepted and the study shows that there is no significant difference in incidence of burst abdomen with polyhydroxybutyrate when compared with interrupted polypropylene and continuous polypropylene. Results from the previous studies from the above table and this study shows that incidence of burst abdomen mostly not related with suture material used.

Most important etiological factor for burst abdomen is wound infections most importantly deep space infections. Although type of suture material doesn't influence wound dehiscence, technical errors in fascial closure may be responsible. Good pre-operative general condition of the patient, adequate fascial closure without tension and good post-operative care are the three main strategies which will prevent the acute wound failure.

Incidence of stitch granuloma in group I, group II and group III in this study are 4.9%, 8.79% and 2.56% respectively (table-2). Study shows that there is significant difference in incidence of stitch granuloma with polyhydroxybutyrate when compared with interrupted polypropylene. Continuous irritation of above skin by higher number of underlying suture knots may be responsible for the increased incidence of suture related complications in interrupted polypropylene technique.

Incidence of suture sinus in group I, group II and group III in this study are 1.96%, 5.49% and 1.28% respectively (Table-2). Study shows that there is significant difference in incidence of suture sinus with polyhydroxybutyrate when compared with interrupted polypropylene.

ORIGINAL ARTICLE

Various Studies	Suture Sinus
Trimbos et al²¹ (n=340) Continuous maxon – Interrupted vicryl -	0 % 1.7 %
Bresler et al²⁸ (n=235) Continuous vicryl – Continuous PDS I Continuous PDS II	0 % 0% 0%
Corman et al²³ (n=161) Interrupted vicryl Interrupted prolene Interrupted nylon	0 % 5.7 % 12.2 %
Wising et al¹⁷ (n=1491) Continuous vicryl Continuous PDS Continuous nylon Interrupted vicryl	1.4 % 3.9 % 7.7 % 1.0 %
Israelson and jonsson⁹ (n-817) Continuous PDS Continuous nylon	0.9 % 0 %
Carlson and condon (n=225) Continuous nylon Continuous maxon	0.2 % 0.2 %
Table 6: Comparison of incidence of suture sinus with various sutures	

Continuous irritation of above skin by higher number of underlying suture knots may be responsible for the increased incidence of suture related complications like stitch granuloma, suture sinus in interrupted polypropylene technique. Though there is no change in morbidity and mortality, prevention of suture related complications like stitch granuloma and suture sinus is very much significant in day to day clinical practice of surgeon, as they may cause chronic wound pain, frequent outpatient visits and decreased psychological compliance towards a specific surgeon. This can be accomplished by use of Continuous technique instead of interrupted technique in rectus sheath closure.

Incidence of suture sinus in group I, group II and group III in this study are 4.9%, 10.98% and 2.56% respectively (Table-3). The study shows that there is significant difference in incidence of chronic wound pain with polyhydroxybutyrate when compared with interrupted polypropylene.

Various Studies	Chronic wound pain Incidence
Trimbos et al²¹ (n=340) Continuous maxon Interrupted vicryl	1.2 % 1.7 %

ORIGINAL ARTICLE

Krukowski et al²⁶ (n=757)	
Continuous PDS	12.8 %
Continuous prolene	13.8 %
Wising et al¹⁷ (n=1491)	
Continuous vicryl	8.6 %
Continuous PDS	8.2 %
Continuous nylon	16.7 %
Interrupted vicryl	4.9 %
Israelson and jonsson⁹ (n=817)	
Continuous PDS	2 %
Continuous nylon	2.7 %
Carlson and condon (n=225)	
Continuous nylon	4.7 %
Continuous maxon	5.3 %
Table 7: Comparison of Incidence of chronic wound pain with various sutures	

Chronic wound pain has been under recognized and often goes untreated, or undertreated. Contributing factors for poor wound pain management are lack of, or inadequate wound pain assessment. As verbalization of pain is considered the most valid indicator of pain, higher incidence of chronic wound pain in interrupted technique may be due to suture related complications. Proper post-operative analgesic care of the surgical wound is very much important in surgical practice because negative consequences of chronic wound pain may be impaired quality of life due to sleep deprivation or disturbances, immobility, depression, changes in body image, constipation due to side effects of pain medications, infection, and stress. Chronic wound pain can have a negative impact on the quality of life.

Avg. time for rectus closure for 10cm mid line incision in group I, group II and group III are 9.20 minutes, 16.50 minutes and 9.40 minutes respectively (Table-4 and Figure-2). Study shows that there is significant difference in time for rectus closure with polyhydroxybutyrate when compared with interrupted polypropylene. Although time for rectus closure not much significant when compared to surgery proper and adequate fascial closure, reduction in time for rectus closure may reduce the overall surgery time and anesthesia related complications and helps in easy post-operative recovery.

CONCLUSIONS: No significant difference observed in incidence of wound infections and burst abdomen in all the 3 groups but relatively higher incidence of wound infections is noted in our hospital. Incidence of stitch granuloma, suture sinus and chronic wound pain is more with interrupted technique than continuous technique and are more with non-absorbable suture material. Incidence of incisional hernias, suture complications like suture sinus, stitch granuloma can be more effectively reduced with slowly absorbable continuous sutures.

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ORIGINAL ARTICLE

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