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Original Research Article

Efficacy of dynamic retention suture compared with open laprostomy in secondary peritonitis patients

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ABSTRACT

Background: Surgical treatment is the cornerstone of treatment of patients of secondary peritonitis and usually comprises elimination of infectious focus with peritoneal lavage. In these patients, the abdomen closure has been an important issue whereby it can be managed either by primary closure or any techniques of laparostomy.
Methods: A randomised prospective study was undertaken with 60 patients of secondary peritonitis regardless of causative etiology and divided into two equally compatible groups, Group A with open laparostomy and Group B who underwent staged closure with Dynamic Retention sutures. They were compared for demographic profile and IAP and pre and post-operative morbidity and ICU stay and pain score with time to resume normal diet and activities and complications encountered during the procedures
Results: On analysis of both groups, the patients undergoing modified bagota also had better outcomes in terms of significantly lower value on pain scale and lesser duration of hospital stay, early resumption of activities however, in failed cases of group A these advantages were outweighed by conversion to open laparostomy hence this calls for appropriate selection of closure technique at the very outset.
Conclusions: The monitoring of post- operative IAP is important in deciding the need for any intervention in open laprostomy as well as Dynamic Retention Sutures with modified Bagota techniques. This definitely prevents ACS in the patients of secondary peritonitis post- operatively.

Keywords: DRS, IAP, ACS

INTRODUCTION

The outcome of peritonitis can be estimated by preoperative and post-resuscitative information, per-operative findings in combination. Acute physiology and chronic health evaluation (APACHE) II score, multiple organ dysfunction score (MODS), Sepsis-related Organ Functional Assessment (SOFA) score are established scoring systems that reflect the severity of patient's disease and correlate with the mortality. Mortality among peritonitis patients with an APACHE II score <10 is around 8% whereas mortality rate rises sharply to 30% in patients with an APACHE II score of 11-152 and peaks at more than 80% at score of >20. The MODS and SOFA score are other scoring systems used to predict mortality of patients with sepsis but these are less applicable to individual patients.

Surgical treatment is the cornerstone of treatment of patients of secondary peritonitis and usually comprises elimination of infectious focus with peritoneal lavage.[1] Peritoneal lavage is performed to reduce the quantity of bacteria and additional substances which serves to support the patient's immune mechanism. In these patients, the abdominal cavity closure has been an important issue where it is managed either by primary closure or by any one techniques of laparostomy. Laparostomy, on the other hand, is a surgical closure method in which the peritoneal cavity is not sutured but kept protected with a temporary coverage followed by a

delayed closure. Raised intra-abdominal pressure (IAP) affect splanchnic, renal and abdominal wall perfusion. Facial wound ischemia and necrosis causing burst abdomen and there is an increased incidence of multi organ failure and mortality and morbidity.

Abdominal pathology itself may lead to intra-abdominal hypertension, resulting from rapid elevation of IAP (intra-abdominal pressure). In post-operative patients raised IAP levels are result of ileus, visceral and peritoneal edema and reduced abdominal wall compliance caused by pain. Uncontrolled IAH may lead to multi organ failure in which all major organ systems are involved, associated with a high morbidity and mortality rate. With development of the abdominal compartment syndrome the mortality can be as high as 50%.[4] However, to minimize the ill effects of closed abdomen, by managing severe secondary peritonitis alternately by open technique following laparotomy carried its own morbid consequences which includes open viscera exposed to the exterior susceptible to exogenous infection. Secondly continuous fluid and electrolyte losses necessitating their proper correction and finally increased risk of bowel fistula formation.

Hence, a theoretical alternative using tension free primary abdominal wall closure technique in candidates likely to develop abdominal wall complications is an attempt to incorporate the advantages of primary closure and exclude the disadvantages of open abdomen. So the study was undertaken to incorporate Modified Bogota technique versus open laparostomy in patients of severe secondary peritonitis and analyzed their results statically.

METHODS

A prospective study was undertaken between Jan 2013 March 2015 at Department of General Surgery, Safdarjung Hospital and Vardhman Mahavir Medical College, with 60 patients of secondary peritonitis regardless of causative etiology. Our Inclusion criteria were all patients with secondary peritonitis with APACHE II Score 10-20 or Post Resuscitation Intra-abdominal Pressure (IAP)>15 mm Hg. Exclusion criteria in our study were all children below 12 years of age and pregnant women.

Randomization

The randomization was done using the closed envelope technique and all patients satisfying the inclusion criteria were randomly divided into two categories 30 patients in the control group (Group A) with open laparostomy and 30 patients in the study group (Group B) who underwent staged closure using modified Bogota technique.

Clinical data

In addition to consent the demographic profile including, age, sex, address, follow up and intra-hospital details were registered: MRD number, data of admission, surgery and discharge, days of hospitalization. History was taken from the patients regarding onset of acute abdomen and duration of abdominal pain, vomiting, distension, obstipation etc. Abdominal examination was done to note for distension, guarding, rigidity, tenderness, rebound tenderness and bowel sounds and preoperative IAP were recorded. After vitals recording, conscious level (Glasgow Coma Scale), hydration, pallor, physical examinations were noted. Blood and radiological investigations included hemogram, hematocrit, blood urea, serum creatinine, serum sodium, serum potassium, random blood sugar, arterial pH, PaO_2, ECG, chest radiograph and ultrasonography of the abdomen to help in the diagnosis of hollow viscera perforation or intra-peritonial collection with internal echoes. Pre-operatively, all patients were given antibiotics ceftriaxone and metrogyl and tramadol.

Pre-operative resuscitation

The patients were adequately resuscitated, the end point of which was defined by a combination of following factors: systolic pressure of more than 100 mm Hg, correction of acidosis and urine output of 1 ml/kg/hour or more. IAP was measured in cm saline and all the patients then underwent midline exploratory laparotomy.

Measurement of intra-abdominal pressure (IAP)

Using a Foley catheter (16-F or 18-F), an intravenous infusion set, a 50 ml syringe, a measuring scale and a hemostat, provided a low-cost assessment of the IAP. The connector of the infusion set was detached from the infusion tubing and was connected to a syringe filled with 50 ml of saline. This was then connected to the main drainage channel of the Foley catheter, and saline was instilled into the empty bladder. The connector was then clamped using a rubber-shod hemostat. The empty syringe was then removed leaving behind the connector attached to the Foley catheter. The intravenous set tubing was next connected to the connector and held vertically above the symphysis. Once the hemostat was released, the saline flowed out of the catheter drainage tube and reached a height (in cm of saline) corresponding to the IAP16. The pressure thus obtained in cm of saline was converted to mm Hg {IAP mmHg = (IAP cm saline) 1.36}

Laparotomy wound management techniques

In the study group B, patients primarily underwent Modified Bogota bag closure. Sterile urobag was tailored to the size of abdominal wound and was placed over the open abdomen (exposed bowel) after making multiple openings of 0.5x 0.5 cm. Intravenous set tube was placed 5 cm lateral to skin edges of the incision on either side using stab incisions through the entire thickness of abdominal wall as retention strings at a distance of 3 cm from each other. These tubes were gradually tightened up

every 24 hours thereby achieving staged delayed primary closure in the form of secondary suturing. Abdominal drainage, where indicated, was provided through a separate stab incision.

RESULTS

Sixty patients of secondary peritonitis were included in the study: 30 in each group (group A: open laparostomy; group B: modified bogota technique).

Age distribution

The mean age of patients in group A was 38 years and in group B was 40 years (Table 1). With 22 were males and 8 were females and group B, 24 patients were males and 6 were females.

Table 1: Mean age in years.

	Group	Mean	Std. deviation
Age	A	34.3	11.51
	B	34.7	13.84
Independent samples test			
		t-test for equality of means	
Age		0.142	>0.05

Pre-operative means APACHE II score

The mean APACHE II Score were comparable in both groups.

Table 2: Mean pre-operative APACHE II score.

	Group	Means	Std deviation
APACHE II	A	14.2	2.86
	B	13.7	2.26
Independent samples test			
		t-test for equality of means	
APACHE II		t	Significance (P)
		0.851	>0.05

Pre-operative mean IAP

The mean pre-operative intra- abdominal pressures were comparable in both groups with 16.9 mm Hg in group A and 16.03 mm Hg in group B.

Etiologies in group A, were ileal perforations in 10 patients, pre, pyloric perforations in 6 patients, duodenal perforation in 3 patients, fecal fistula in 5 patients, haemoperitonium in 2 patients, pyoperitonium in 1 patient, ruptured liver abscesses in 1 patients and abdominal tuberculosis in 2 patients.

In group B, 11 patients had ileal perforations, 5 patients had duodenal perforation, 3 patients had Koch abdomen 1 patients had pre- pyloric perforations, 1 patients had fecal fistula, 1 patients were of ruptured liver abscess, 1 patients had bowel gangrene, 1 patient each of jejuna perforation, pyoperitonium, appendicular perforation, caecal perforation, 2 patients had sigmoid perforation, uterine rupture and depending on the surgeon's decision based on the intra- operative findings 11 in group A and 17 in group B.

Table 3: Mean pre-op IAP.

	Group	Means	Std deviation
Pre-operative IAP	A	16.9	1.84
	B	16.03	1.71
Independent **samples test**			
		t-test for equality of means	
Pre-operative IAP		T	Significance (P)
		0.79	>0.05

Table 4: Mean post-op IAP.

	Group	Mean	Std. Deviation
Post Op IAP	A	11.9	3.42
	B	10.4	2.52
Independent samples test			
		t-test for equality of means	
Post Op IAP		T	Significance (P)
		2.07	<.05

Table 5: Mean post-op time to resume oral diet.

	Group	Mean	Std. Deviation
Oral diet	A	6.53	2.78
	B	5.73	2.28
Independent samples test			
		t-test for equality of means	
Oral diet		T	Significance (P)
		1.23	>0.05

Table 6: Mean pain score.

	Group	Mean	Std. Deviation
Pain	A	6.6	1.13
	B	6.06	1.23
Independent samples test			
		t-test for equality of means	
Pain		T	Significance (P)
		1.747	>0.05

Table 7: Mean duration of hospital stay.

	Group	Mean	Std. deviation
Hospital stay	A	22.1	7.63
	B	19.2	6.68
Independent samples test			
		t-test for equality of means	
		T	Significance (P)
Hospital stay		1.60	>0.05

Post-operative IAP

The mean post-operative IAP measured on post-operative day 1 was 11.9 mm Hg in group A and 10.4 mm Hg in group B.

Post-operative time to resume oral diet

The mean post - operative duration to resume oral was 6.53 days in group A and 5.73 days in group B.

Pain score VAS

The mean pain score as assessed by the Visual Analog Scale on post- operative day 2 was 7.6 in group A and 7.3 in group B.

Duration of hospital stay

The mean duration of hospital stay in group A was 22.1 days and in group B was 19.2 days.

ICU stay

In group A, 6 out of 30 had to be admitted in the ICU post operatively while in group B, 5 out of 30 had to be admitted in the ICU operatively. In group A, 4 out of 30 and In group B, 3 out 30 was expired in post-operative period.

Pre-operative IAP and post-operative IAP

The mean pre-operative IAP measured was 16.9 mm Hg in group A and 16.03 mm Hg in group B The mean Post-operative IAP day 1 was 11.9 mm Hg in group A and 10.4 mm Hg in group B.

Table 8: Mean pre-op IAP and mean post-op IAP.

	Group	Mean	Std. deviation
Pre Op IAP	A	16.9	1.84
	B	16.5	1.71
Post op IAP	A	11.9	3.42
	B	10.4	2.52
Independent samples test			
		t-test for Equality of Means	
		T	Significance (P)
pre Op IAP		0.797	>0.05
Post op IAP		2.01	<0.05

Complications and failures

(50%) in group A (open laparostomy) were discharged without any complications of failure of the procedure. Among the 15patients who developed persistent infection 12 (40%) and fecal fistula 3 (10%).The overall wound complication rate in group A was found to be 50%.

In group B (Modified Bogota Closure), 18 patients were discharged without any complications of failure of the procedure. Among 12 patients 2 patients (6.66%) developed enteroculancous fistulae. 10 patients (33.33%) had persistent infection. The overall wound complication. Rate in group B was found to be 40%

Pain, time to resume oral diet and hospital stay in failed cases

Among the failed cases in both the group, the mean pain score, mean time to resume oral diet and mean duration of hospital stay were compared and the following results were observed;

- The mean pain score assessed by Visual Analog scale was similar in both the groups (6.6 in group A, 6.5 in group B, P>0.05).
- The mean duration of hospital stay was however significantly higher in the group A failed cases (27.7 days in group A, 24.5 days in group B, P<0.05) (Table 9).
- The mean time to resume oral diet in both group (7.93 in group A and 7.09 in group in group B, p>0.05).

Table 9: Pain, time to resume oral diet and hospital stay in the failed cases.

	Group	N	Mean
Pain	A	15	6.6
	B	12	5.7
Oral diet	A	15	7.93
	B	12	7.03
Hospital stay	A	15	27.7
	B	12	24.5

Table 10: Pain, time to resume oral diet and hospital stay in the success cases.

	Group	N	Mean
Pain	A	15	6.6
	B	12	5.7
Oral Diet	A	15	5.5
	B	12	5.2
Hospital Stay	A	15	16.6
	B	12	10.1

Pain, time to resume oral diet and hospital stay in successful case

On comparing the outcome variables among the successful cases of both the groups, following observations were noted:

- The mean pain score was lower in group B (5.7) than in group A (6.6), the difference being

- The mean duration to resume oral diet was however comparable between the two groups (5.5 days) in group A vs. 5.2 days in group B, P>0.05)
- The mean duration of hospital stay was however in group A cases (16.6 days) than the patients in group B who achieved delayed primary closure (10.11 days), the difference was statistically significant (P<0.05).

DISCUSSION

The benefit of laprostomy in intra-abdominal is sepsis is with the added advantage over planned re laprotomies as planned second look procedure on demand to control sepsis, collection, intrabadominal leaks and to monitor the development of ACS leading to multiorgan failure. A well conducted randomized study was done keeping all the above factors of secondary peritonitis with benefit of open abdomen with delayed ventral hernias formation v/s application of dynamic retention sutures via intravenous pipe tubing's for approximation of all the layers of the abdominal wall with close monitoring of IAP in two groups.

The significant decrease in the incidence of ACS with reduced IAP in both the groups definitely substantiates that whatever technique followed the benefit of laprostomy is mandatory in damage control procedure with definite reduction in development of multiorgan failure. The groups were compatible in terms of age, sex, etiopathogenesis pre and post IAP APACHE II Score, Pain score (VAS), ICU requirements and mortality factors. The mean age in the DRS was 34.27 and 34.73 in laprostomy group which is comparable with study done by Shahtaf khan et al 43 with mean age of 34.78 while that of Dogan Gonullu et al was 63.50 years.[25]

The mean APACHE II score was 14.2 in group A and 13.6 in group B which was correspondingly similar to Renger JL et al in which he studied only open abdomen with APACHE II score of 17.8 to 24.7 and also 8 series reported by Pieter Boele van Hensbrock et al.[5,26]

The cause of peritonitis in group was small bowel perforation was 33.33% with enteric perforation followed by prepyloric perforation was 19.98%, fecal fistula in 16.60% and others 26.40%. In group B the common etiology was small bowel perforation in 36.67% followed by duodenal perforation in 16.60% pyloric perforation 10%and others 36.60%. The etiological incidences are similar to study by other Indian and Asian studies by Karthic et al and Sharma et al and Gupta et al.[5,6,23] Dogan Gonullu et al also included colorectal malignancy (37.8%) while small bowel perforation was 10.8% while 10.8% were gangrenous bowel.[5]

The incidence of infection in our study group was 40% in group A and 33.33% in group B with DRS. Enterocutaneous fistula was 10% in group A and in group B was 6.66%with DRS. This is higher than the infection ratre quoted by Gracia Iniguez JA, Orozco CF, Mucino Hernandez MI, Ortigo AL and Trahalo SS et al whereby it was only 24%.[43]

Kirshtein B et al concluded there is an added disadvantage of evisceration, fistula formation, difficult incisional hernia but Laprostomy is better accepted technique of secondary peritonitis managed by covering with Bagota bag.[41] They further said that laprostomy also permits to observe the intraabdominal infection and soft tissue necrosis monitoring without undergoing second laprotomy.

The higher level of infection in our control group may be attributed to large surface area exposed to urobag laprostomy with artificial holes made for the serous exudates to seep out. The urobag dressing was changed at frequent interval and pus culture taken with antibiotic coverage given accordingly.

The wound infection in our study group was DRS was 33.33% and it is higher than 23.33% reported by Marwah et al where seroma formation was a major complication.[29] Actually they undertook a rectus sheath turnover flap and relaxation incision technique for approximation of abdominal wall.

The main etiopathogenesis was typhoid fever in both group A and B with 33.33% and 36.67% respectively. In Adesunkanmi AR, Ajao OG et al reported 38% enteric fever in their series.[23] The parameter was APACHEII was taken into consideration in our study group. While Dogan Gonullu et al reported significant difference in survivors and non survivors according to initial APACHE II score.[25] Their mortality was 43.20% with non survivors having a higher APACHE II score (p=0.001). Ajao et al 23 studied enteric perforation and reported 34% wound dehiscence in 50 cases study done.

Peter Boele Van Hansebrock, Jan Wind Marcel GW26 reported 85% closure rate with DRS while the success rate in our study group was 60%, which was attributed to the intermediate risk of patients included in our study with mean APACHE II score of 13.7. In Dogan Gonullu et al reported a failure rate of 76.4% with Bagota Bag technique as they also included patients with APACHE II score of more than 20 in their study.[25]

Among other complications enterocutaneous fistula was noted in 10% of laprostomy group and 6.66% in DRS group. Aderson O et al reported 13% enterocutaneous fistula in high risk patients.[20] Miller RS et al reported 25% of wound infection with abscess and enterocutaneous fistula in 334 patients taken up for damage control study of open abdomen. Nicholas JM et al reported 14% and 18% cases with infection and fistula formation.[18] Sirtton et al reported 34% fistula formation in their study group of open abdomen. The lower incidence of fistula formation in our study group may be attributed to gradual approximation of abdominal wall by

DRS keeping the visceral bowel less exposed as compared to open laprostomy where fistula rate was 10%.

The pain score in both the group were compared on VAS with mean of 6.6 in group A and 6.03 in DRS suture group. The pain score of laprostomy was more or less acceptable by the patient as compared to DRS where comfort level was much higher and patient volunteered for DRS group by early ambulation even though the multiple punctured sites of DRS added to the pain during change of posture. In the sub group analysis the mean pain score in group A was same in failed cases and in successful cases 6.6 versus 6.6. In group B the mean pain score was comparable between failed and successful cases respectively. Sanjay Marwah et al reported a higher pain score on DRS technique when compared to rectus sheath relaxation which may contributed by high tension approximation of DRS.[29]

The mean duration of hospital stay was significantly higher in failed cases 27.7 days versus 16.6 days in successful cases. The mean duration of hospital stay among failed cases was 24.5 days which is significantly higher than patients discharged successfully (10.01 days).

The mean preoperative IAP in group A was 16.9 and 16.3 in group B as they were randomized trial and increase IAP was indicative of co morbid conditions adding to development of ACS.

Post-operative IAP was significantly lower with mean of 11.9 and 10.4 in group A and B respectively. While Ari K Lepparniemi et al, reported median IAP of 31.4 preoperatively and 54% of the patients had improved renal and respiratory functions after decompression.[24] SOFA score (Sequential Organ Failure Assessment) was taken into consideration reported as while Mentula P Hienorin et al reported early laprostomy as surgical decompression to improve respiratory and renal complication with reduced mortality rates.[12] The mean duration to resume oral diet was found comparable as it was resumed in both the groups A and B were 5.6 days and 6.7 days respectively which indirectly signifies that both the groups had same co morbid conditions. Early resumption of oral diet also signifies decrease rate of entero- cutaneous fistula formation and ICU support. Hospital stay in group A was22.1 days and in DRS group B was 19.2 days which is again attributed to early return to work Excluding the failed cases in DRS the hospital stay was further shortened by 10 days . ICU support was actually required by 6 patients in group A and 5 patients in group B for respiratory support and monitoring of multiorgan failure.

Bossacha K, Hulstaert PF et al reported intra-abdominal complication similar to that quoted by Dogan et al of approximately 32.4% while compared to our study the morbidity was 50% in group A and 40% in group B.[25] This is again attributed to higher APACHE score with average 14.2 preoperative value. Dogan et al reported mortality in 2 patients each with small bowel perforation and perforated malignant colorectal diseases while 4 patients had mortality because of multi organ failure without intra-abdominal complication.[25] Patients with higher preoperative APACHE II score had higher mortality. Sharpiro Jenkins et al reported 50% decrease in mortality by open laprostomy and planned relaprotomy with cumulative 100 % damage control.[11] Mortality rate was 43.3% in Dogan Gonollu et al series and 46%in Leppeninni et al where 18 % cases were early decompression.[24,25] In our study 13.33% and 10 % were mortality rate in group A and B respectively. Rutherford EJ et al concluded that besides bagota bag other options of towel clip closure, polyglycolic acid mesh, polygalacton 910 mesh zipper and vac is equally appropriate available options for temporary abdominal closure.[43] Temporary abdominal wall closure using bagota bag is an inexpensive simple method with added advantage of relook and evaluation of abdominal visceras and damage control method for early recognization of infection, gangrene etc.

CONCLUSION

In our study of 60 patients, primary abdomen closure using Modified Bogota technique following laparostomy in patients of severe secondary peritonitis had better outcomes in terms of significantly lower value on pain scale and lesser duration of hospital stay, however, in failed cases of group A these advantages were outweighed by conversion to open laparostomy hence this calls for appropriate selection of closure technique at the very outset.

In the subgroup analysis, however, the failure were found to be higher in the group B with APACHE II >=15 and/or pre op IAP >16. The patients within this high intermediate risk subgroup having higher scores therefore may have been managed primarily open laparostomy technique as:

- The mean pain score of the group A failed cases was found comparable with that of the failed cases of group B
- The mean duration of hospital stay in these patients (group B failed cases) was higher than the cases (group B successful case), as they had to be managed again by open laparostomy technique. These patients (group B failed cases) therefore, had to undergo three procedure during their course in the hospital viz. open laparostomy, Modified Bogota
- It was psychologically traumatic for these patients besides being a drain on the hospital resources
- They were also more likely to develop organ failure and poor survival as evidenced by the 13.32% mortality in group A in comparison to 10% in group B.

The pain score and the mean duration of hospital stay were lower group B successful cases when compared to that in group A and these patients had to undergo a second procedure which was logistically cumbersome, psychologically traumatic and cosmetically grotesque.

The pre-operative APACHE II score, MPI score and post resuscitation IAP either individually or in combination, can therefore, predict the wound failure rates, choice of closure techniques (as shown by logistic regression analysis) and requirement of ICU care in patients of secondary peritonitis in the post-operative period but better correlation needs to be studied in a larger sample.

The monitoring of post-operative IAP was helpful in deciding the need for any intervention in group A and to adjust the degree of approximation of wound edges in group B. Therefore this index can be used to pr event ACS in the patients of secondary peritonitis post-operatively.

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