TITLE

Laparostomy and temporary abdominal closure outcomes in emergency non-trauma surgery and parameters affecting early definite primary fascial closure

AUTHORS

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ABSTRACT

Background

The open abdomen or laparostomy is a great advance of surgery based on the concept of damage control surgery. Aim of the study is to review the laparostomy outcomes of non-trauma emergency surgery patients in a district general hospital and identify parameters affecting early definite primary fascial closure.

Methods

The records of all non-trauma emergency surgical patients who underwent laparostomy in a three-year period in a single institute were studied retrospectively. Outcomes included length of stay, morbidity, mortality, readmission rates, number of re-look operations, rate of definite primary fascial closure and time to closure.

Results

Thirty-two patients were included. Morbidity was 84.4% and mortality rates were 21.9% (in-Hospital), 18.8% (30-day) and 46.9% (overall). Median length of hospital stay was 22 days. Rate of primary fascial closure was 87.5% and median time to closure was two days. The number of relook operations was the only independent prognostic factor of definite early primary fascial closure, with higher rates of closure in patients with 1-2 relooks.

Conclusions

Although the open abdomen has been demonstrated to improve survival, the precise role in abdominal sepsis has not been elucidated. Current consensus does not support use of open abdomen routinely, however in selected situations it becomes unavoidable. Laparostomy is a valid option in non-trauma emergency surgery and can be managed safely in a district hospital. High closure rates can be achieved if one or two re-look operations are performed with an early attempt for closure.

Keywords: laparostomy, mortality, morbidity

TEXT

INTRODUCTION

The open abdomen (OA),created by leaving the fascial edges intentionally unapproximated, is a great advance of surgery based on the concept of damage control surgery (DCS) developed in 1980[1] and on the realization that the correction of metabolic failure rather than anatomic perfection is mandatory for survival[2]. Previously, the first investigator to describe and propose the method of OA or laparostomy was Von Miculicz-Radecki in 1884 [3]. OA and its current synonyms, laparostomy and temporary abdominal closure (TAC), are considered to improve survival[4] and therefore they are currently applied in several conditions including the abdominal compartment syndrome, trauma, peritonitis, pancreatitis, necrotising fasciitis, retroperitoneal haematomas, hemodynamic instability, abdominal wall tissue loss, poor fascial condition, anticipated need for re-laparotomy and deferral of definite intervention[1, 5-8]. OA allows easy repeated access for consecutive drainages and debridements, inspection, decompression and easier respiratory modulation[9]. However, it is argued that the supporting evidence for DCS in non-trauma patients is insufficient and not well described[2, 10]. Large studies include mainly young trauma patients[11] and in a recent meta-analysis only four of them excluded trauma patients who comprise a group of patients with different physiology from the emergency surgical patients[12].

Fascial closure (FC) can be delayed by infection, nutritional and respiratory status, ileus, fluid resuscitation, abdominal wall oedema and fistulas[7, 13, 14]. Definite fascial closure (DFC) is the goal for all OA patients[7, 13, 15-17]. Prolonged OA requires special skills and nursing care[18] and can lead to many issues such as nutritional problems, loss of domain, frozen abdomen, fistulas, intense systemic inflammatory responses and long hospital and intensive care unit (ICU) stays[1, 4, 13, 17, 19]. Most authors nowadays agree that the most important aim is to achieve primary fascial closure (PFC) as early as possible[1, 4, 12, 13, 17, 19-21] in favour of survival, morbidity, cost and resources utilization [1, 4, 12, 13, 17, 19-21]. In addition, early PFC improves the outcomes of future abdominal wall repairs [4, 22, 23]. In line with recently established recommendations outlining the management of OA [4], PFC should ideally be achieved during initial hospitalization[10, 18, 20, 24] or within first 7-14 days, as otherwise adhesions and fascial retraction make it impossible and increases the rate of complications[7, 13, 16, 19, 25, 26].

Although various factors such as septic complications, the duration of OA, the fluid balance and the number of re-operations have been previously suggested to be associated with the rate of successful PFC, the parameters associated with the successful PFC after DCS in non trauma patients have not been sufficiently investigated[27]. Aim of the present study was to review the

outcomes of laparostomy for non trauma emergency general surgery in a single institution and to identify parameters that affect the likelihood of early definite PFC following OA and TAC.

MATERIALS (PATIENTS) AND METHODS

The conduction of this work was in full compliance with local Ethical Regulations and Anonymization standards. Approval from local ethical committee was not required as this was a non-interventional study, involving retrospective analysis of clinical data associated with diagnostic and therapeutic techniques performed without deviation from institute's local guidelines. The study analysed data retrospectively thus informed consent from the patients prior to their inclusion was not required according to local policy.

The records of all consecutive non-trauma emergency general surgical patients who underwent a laparostomy in three-year period in a single district hospital were studied retrospectively. The parameters studied are included in Table I. The outcomes studied comprise morbidity, in-Hospital mortality, 30-day mortality, overall mortality, hospital stay and hospital readmissions, ICU stay and ICU readmissions, the rate of definite PFC, the time to definite primary closure (TTC), the number of relook operations and overall survival. The operation at which a laparostomy was initially decided was considered as the index operation. Patient commorbidities were evaluated according to the Charlson Comorbidity Index (CCI). Hospital readmissions were defined as any acute readmissions in hospital related to the initial pathology and its management. ICU readmissions were defined as readmissions to ICU during same hospitalization. TTC was defined as the number of days between index operation and time of definite PFC. Follow-up was calculated from index operation up to last clinic appointment or date of death. In line with the Open Abdomen Advisory Panel recommendations [4], early definite fascial closure was defined as fascial closure within the same hospitalization. Overall survival and mortality were calculated based on existing real-time online data system demonstrating the current patient's status.

The technique most commonly used is a variation of Bogota Bag (BB), first described in 1984 [24]. At the index surgery, based on the severity of the disease and other factors [4, 7, 25, 28], after adequate source control, a three-litre bag is sutured to the skin or the fascia[1, 6, 9, 21, 29] and further sealing is achieved with transparent adhesive sheet[6, 7] or surgical pads placed laterally to the wound, to allow direct visualization of the intestine and to control possible excessive losses of fluids. The patient is then transferred to ICU for invasive monitoring, mechanical ventilation, haemodynamic support and correction of both electrolyte and coagulation abnormalities, followed by elective return in theatre after 24-48 hours for PFC or further washout, debridement or other surgical management[1, 4, 7, 25, 30, 31]. Initial plans on the timing of

reoperation are made during the primary intervention and are based on the surgeon's subjective assessment of severity of the individual patient's disease[30]. The patient can return sooner to theatre if deterioration is identified, if high drainage output is recorded and if the TAC fails or re-exploration can be delayed until physiological parameters such as coagulopathy, acidosis and hyperthermia are resolved[1, 7]. Prolonging the OA and the type of surgery are decided at each surgical revision.

Statistical analysis

Bivariate correlations were assessed using Fisher's exact test for dichotomous categorical variables and chi-squared for categorical variables with more than two groups. Medians were compared across groups using Man Whitney U test for binary groups and Independent sample median test for categorical variables with more than two groups. Kaplan Meier analysis was used to assess likelihood of definite closure along time or number of relooks, and Log rank was implemented to assess statistical significance of comparisons. A p value of <0.05 was considered statistically significant. Two-tailed comparisons were consistently used where applicable. Statistical analysis was conducted using SPSS v23 (IBM, Armonk, NY, USA).

RESULTS

Thirty-two patients were included in the study. Patients' characteristics including ASA classification, CCI classification, indications for laparostomy and types of index procedures performed (including stoma formation) are demonstrated in Table 1. Morbidity of the study was 84.4%, while in-Hospital, 30-day and overall mortality were 21.9%, 18.8% and 46.9% respectively. Median length of hospital stay and ICU stay were 22 (range: 2-365) and 10 (range: 2-140) days respectively, with rates of hospital readmissions of 37.5% and ICU readmission of 18.8%. The reasons for hospital readmission included AKI/dehydration in five cases, septic complications in five cases, respiratory complications in two cases (pleural effusion, pulmonary oedema) and severe abdominal pain in one case. Median length of follow–up was 21 months (range: 1-54). The median number of relook operations was one (range: 1-4), with a PFC rate of 87.5% and a median TTC of two days (range: 1-9). Overall survival was 21 months (1-54). All four patients not primarily closed had survived through the initial hospitalization and were discharged with Vacuum Assisted Closure (VAC) applied, aiming for delayed FC. Out of these four patients, two patients were still alive at latest follow-up. Multivariate analysis showed that overall survival was significantly associated with age (RR=1.057, 95%CI: 1.013 - 1.104, p=0.011) and CCI (RR=1.516, 95%CI: 1.100 - 2.088, p=0.011). Importantly, no statistical correlation was identified between all types of mortality and type of pathology, ASA or number of relook operations. The analysis further demonstrated

that the number of relook operations was the only independent prognostic factor of definite early PFC (Table II), with higher rates of closure in patients who had 1-2 relooks (Figure 1, 2). Consecutive clustering of one or two relooks versus three or more and subsequent assessment of the correlation of these two groups with the rate of early definite PFC, demonstrated a statistically significantly higher PFC rate for patients that had only 1-2 relooks (n=26/26) compared to that of patients that had 3-4 relooks (n=2/6) ($p<0.001$) (Figure 3).

DISCUSSION

Although the OA has been demonstrated to improve survival[13, 20], the precise role in abdominal sepsis has not been yet elucidated[1, 5]. Comparing to trauma patients, the complications of OA are more frequent and the rates of primary closure are lower [13]. Morbidity and mortality is determined by the period for delayed closure [19, 32-34], which can often be very long in these patients[32].

In the present study, the overall postoperative morbidity rate was slightly higher than the literature rate (15.8 – 81.0%)[6, 7, 9, 16, 27, 32], although some studies report up to 100% morbidity [33]. This is likely due to the different ways complications are classified and reported, especially in retrospective studies where they can often be underestimated [8]. On the other hand the fistula rate was low (n=1/32) compared to other studies[4, 35] which can be explained by the rate of early PFC achieved and the low number of relook operations, previously known to be associated with higher fistula rates [5, 26, 32].

In-hospital mortality, 30-day mortality and overall mortality were comparable to other relevant studies (0-55%[2, 6, 10, 29, 30, 35], 0–50%[29] and 11.1-65.8%[14, 35-37] respectively). Although it has been previously suggested that survival is affected by the type or severity of disease[17, 30, 32, 35, 36], in the current study indication for surgery and ASA did not affect the outcomes[11]. On the other hand, survival was affected by age [15, 36], as well as by CCI.

A high percentage of early definite PFC in the same admission was achieved in the current study. A recent systematic review and meta-analysis of 74 studies has described a wide range of PFC from 3.2 - 100%[35], while a recent meta-analyses of 3125 patients, including though trauma patients, showed an early PFC rate of 62% (29-85%)[12].

The median number opof relook operations as well as the median TTC, is comparable with the relevant published lit]erature[2, 7, 9, 12, 25, 26, 32, 36]. The number of re-look operations was the only independent prognostic factor for early PFC, in agreement with other investigators[7, 20, 27, 32, 35].

As shown in the present results, patients who had 1-2 relooks had three times more chances to achieve early definite PFC which in most cases was achieved within the first 2-3 days (Figure 4), although TTC was not found in the present study to be an independent prognostic factor for

PFC in multivariate analysis. The type of initial pathology, considered previously important[18, 20, 26, 35], as well as other factors such as the presence of septic complications, the duration of OA [15, 16, 27, 38] and the presence of stoma in index operation[39] were not demonstrated to be statistically relevant in this case.

Various techniques have been described for temporary abdominal closure including Vacuum Assisted Closure, artificial burr, meshes, zippers, silo or BB, skin closure only, packing, retention and dynamic retention sutures, Wittman's patch, towel clips [4, 8, 9, 25, 40]. The ideal TAC should protect the viscera, prevent adherence of the viscera to the materials and contamination of the peritoneum, minimize abdominal wall damage, control drainage of fluids and intra-abdominal pressure, facilitate primary closure, allow rapid access, present acceptable morbidity and mortality, and be rapidly applied, cheap and durable [1, 4, 7, 18, 19, 21, 33]. However there is no clear consensus on the technique to be used [1, 4, 19, 32]. BB was used in the majority of patients in the present study similarly to other studies on the basis of its advantages such as availability, cost, easy and fast application, visibility, facilitation of revisions and decompression, absence of allergies and reactions [6, 9, 32, 36].

Limitations of the study include the heterogeneous cohort, and the possibility of bias related to surgeons' experience. The study did not evaluate factors such as cost, nutrition, use of fluids and medications.

Comparison of studies is difficult due to their retrospective nature, the sample sizes and the biases in techniques, indications and patient selection as well as factors overlooked by many studies like cost, nutrition, level of nursing care and ICU support, quality of surgical intervention and complexity of sepsis management[8, 12, 29, 35]. Moreover, there is lack of standardization in terms such as early, delayed and primary FC [1, 11-13, 17, 35, 39]. Moreover, several authors do not provide any clarification on their terminology used. In order to overcome these variations the authors have adopted the definition provided by recent best evidence recommendations considering as early definite closure any FC within the initial hospitalization[4, 10, 16].

Current consensus does not support use of OA routinely[1, 30], however in selected situations such as tissue loss, poor fascial condition, extreme visceral or retroperitoneal oedema, ACS or planned reoperation it becomes unavoidable[5, 18]. In these cases it is imperative for the process of closure to start at the first relook[4], as early FC predisposes to fewer complications[21, 26] and is technically easier[10, 13, 16, 17, 26].

CONCLUSION

The present study demonstrates that even in lack of strong evidence, laparostomy can be considered a valid option in non-trauma emergency patients and can be managed safely in a district hospital. High PFC rate can be achieved if one or two re-looks are performed with an early attempt for closure. Correct selection of patients is paramount [33, 41].

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NOTES

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

AUTHORS CONTRIBUTIONS

Dimitrios Zosimas has contributed to the concept and design of the work, the acquisition, analysis and interpretation of data for the work, has drafted the work, has made final approval of the version to be published and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Panagis M. Lykoudis has contributed to the concept and design of the work and the analysis and interpretation of data for the work, has revised it critically for important intellectual content,has made final approval of the version to be published and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Bogdan Ivanov has contributed to the concept and design of the work, the acquisition, analysis and interpretation of data for the work, has revised it critically for important intellectual content,has made final approval of the version to be published and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Clive Hepworth has contributed to the concept and design of the work , analysis and interpretation of data for the work, made final approval of the version to be published and agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

TABLES

Table I

Characteristics of patients included in the study.

Characteristics	
Age (years)[†]	69 (19-91)
Gender [‡]	
Male	14 (43.8)
Female	18 (56.2)
ASA[‡]	
1	1(3.1)
2	5(15.6)
3	9(28.1)
4	16(50.0)
5	1(3.1)
CCI [‡]	
0	12 (37.5)
1	3 (9.4)
2	4 (12.5)
3	5 (15.6)
4	5 (15.6)
5	1 (3.1)
6	2 (6.3)
Indications	
Bowel ischemia	8 (25.0)
Anastomotic/stump leak	5 (15.6)
Bleeding	4 (12.5)
Perforation	11 (34.4)
Obstruction/volvulus	1 (3.1)
Other [§]	3 (9.4)
Type of surgery	
Bowel resection	
Yes	20 (62.5)
No[‖]	12 (37.5)
Stoma formation[‡]	

Yes	4 (12.5)
No	28 (87.5)

† median (range)

‡ n (%)

§ intra-abdominal abscesses/sepsis, Abdominal Compartment Syndrome

ǁ washout, drainage, packing, suturing

Table II

Factors predicting definite early primary fascial closure: Results of statistical (bivariate and multivariate) analysis

Predicting factors	Bivariate analysis *	Multivariate analysis *	Risk Ratio
Age	0.805	-	-
Gender	1.000	-	-
ASA classification	0.663	-	-
CCI grading	0.129	-	-
Indication	0.886	-	-
Type of operation	0.829	-	-
Stoma formation	0.431	-	-
Morbidity	1.000	-	-
ICU stay	0.082	>0.05	-
Readmission to ICU	0.150	-	-
Length of hospital stay	0.279	-	-
Number of relooks	0.001	0.015	0.098 (0.015-0.639)†

* p values

† (95% Confidence Interval)

FIGURES

Figure 1

Comparison of definite closure along time, amongst groups of number of relooks

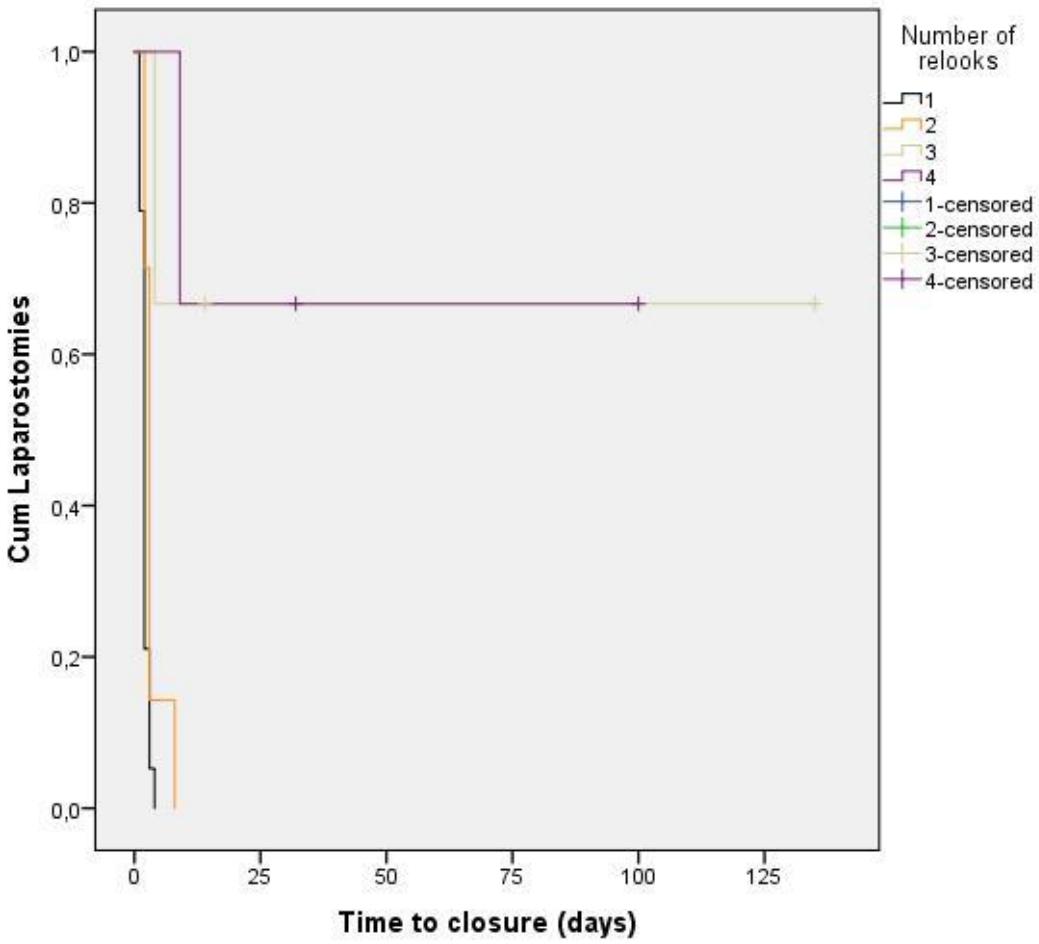

Figure 2

Comparison of definite closure along time, between patients that underwent 1-2 relooks and those that underwent >2 relooks

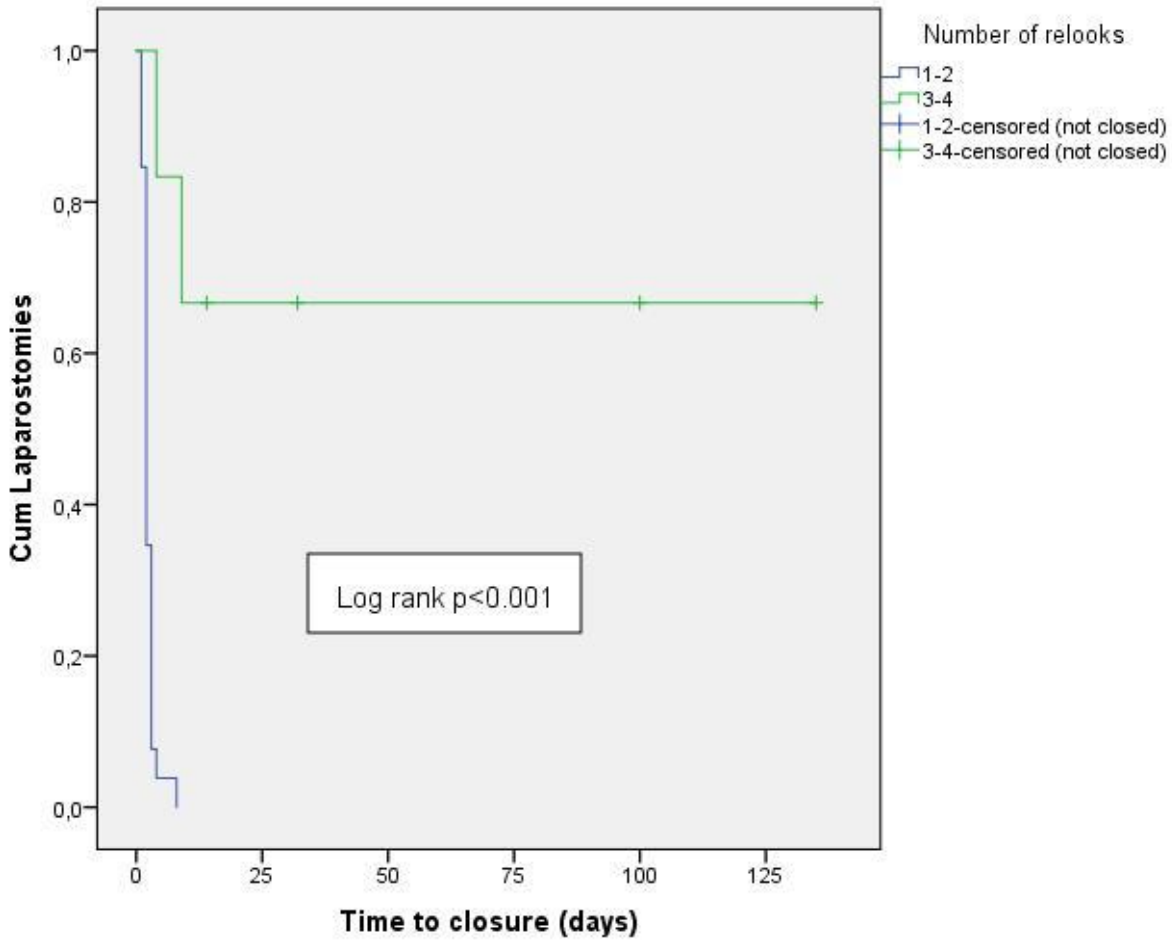

Figure 3

Achievement of definite closure along number of days following index operation