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Impact of Open Abdominal Wound on Quality of Life in Trauma Patients

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Abstract

Background: Damage control surgery using Open Abdomen (OA) for intraabdominal injuries has come a long way from its initial use during wartimes in 1940 as reported by Ogilvie. Open abdomen treatment is proven to reduce rates of intraabdominal hypertension following post-intraabdominal trauma and to produce better immediate patient outcomes in Damage Control Surgery (DCS). However, a deficit of information on its effects on quality of life in patients has led to reluctance to use it in our local setting. This study aims to provide more information on the effects of open abdomen treatment and to help us better understand the usage and prove that this treatment does not affect the quality of life in trauma patients in the long run and can be adapted as a possible routine treatment in DCS for intraabdominal injuries in future.

Methods: This is a single-center prospective cohort study of trauma patients who suffered blunt or penetrating abdominal trauma and underwent either the open abdomen or the closed abdomen DCS under an emergency setting in Hospital Sultanah Aminah Johor Bahru from January 2018 to May 2019. Patients were called for a follow-up interview 6 months to 12 months after their surgery in the surgical outpatient clinic or *via* phone interview. Patients would answer a questionnaire (RAND-36) to assess 9 different domains pertaining to the quality of life (i.e., physical function, emotional well-being, etc.). Length of hospital stay, duration of ICU stays and post-operative complications (i.e., enterocutaneous fistula, Intraabdominal Hypertension (IAH) requiring relaparotomy) were obtained from the trauma registry of the same hospital. Independent t-test was used to compare all nine quality of life domains and length of hospital and ICU stay, and the chi-square test was used to compare rates of post-operative complications.

Results: Sixty-three patients were recruited for this study; 27 in the Open Abdomen (OA) arm and 36 in the closed Abdomen Arm (CA). Mean ± SD ISS score was 14.11 ± 4.81 for the OA group and 12.44 ± 3.64 for the CA group (p: 0.12). Our study shows no significant differences in length of hospital stay, development of chronic post-op pain, and the incidence of enterocutaneous fistula or incisional hernia. However, there are significant differences in the duration of ICU stay, rates of relaparotomy secondary to IAH and social functioning. Mean ± SD for the duration of ICU stay is 6.00 ± 2.48 in OA; 0.75 ± 1.74 in CA ($p<0.05$). Mean ± SD for social functioning is 71.83 ± 22.61 in OA; 84.50 ± 17.92 in CA (p: 0.016). Odds ratio ± 95% CI for relaparotomy secondary to IAH is 1.16 ± 1.01 (p: 0.04). Interestingly, only a single patient was reported to develop enterocutaneous fistula from the OA group, and only 2 patients developed an incisional hernia, both from the OA group, which is not statistically significant based on chi-square analysis.

Conclusion: There is no significant difference in the development of other post-operative complications, and both groups generally acquire a good quality of life in the long run. Open abdomen treatment can be well adapted into the practice of Damage Control Surgery (DCS) without the fear of diminishing the patient's quality of life.

Keywords: Intraabdominal injury; Quality of life; Open abdomen; Laparostomy; Trauma; Damage control surgery

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Introduction

In World War II, Open Abdomen surgery (OA) was introduced to manage the exsanguination of trauma patients, as described by Ogilvie [1]. The term "Open Abdomen" (OA) here refers to a surgically created defect in the abdominal wall that exposes abdominal viscera. In the 1980s, Stone et al. described using sponges for abdominal tamponade as an adjunct to laparotomy, which proved

effective in organ injury control [2]. Subsequently, Rotondo et al. [3] also reported that tackling all injuries in the same manner did not improve the outcomes for patients who suffered from multiorgan and severe vascular injuries. Hence, the term Damage Control Surgery (DCS) was born in 1993 [4]. Damage control surgery is defined as the "initial control of hemorrhage and contamination followed by intraperitoneal packing and rapid closure" to allow for "resuscitation to normal physiology in the intensive care unit and a subsequent definitive re-exploration [5]."

OA has been widely used in civilian trauma cases and has undergone much evolution. During the resuscitative phase of trauma treatment, the deathly triad of hypothermia, acidosis and coagulopathy is well known to increase patient morbidity and mortality rates. Aggressive fluid resuscitation and massive blood transfusion leading to increased mucosal edema often resulted in raised intraabdominal pressure. The development of intraabdominal hypertension (IAP>12 mmHg) post-laparotomy often had dire consequences, namely renal, hepatic and circulatory dysfunction [5]. The development of the concept of damage control laparotomy and the understanding of the abdominal compartment syndrome (IAP>20 mmHg) result in the increasing incidence of elective temporarily open abdomen following trauma (23% of trauma laparotomies in one level 1 center) [2]. However, the usage of OA in our local settings is sparse, and practice is more experimental than routine, leading to inadequate data on the effects it has on our local trauma management.

Although OA is a lifesaving treatment for trauma patients, the success of surgery must also consider the commonly unpleasant postoperative symptoms that can significantly affect a patient's lifestyle and activities. Quality of Life (QOL) is increasingly becoming an important outcome measure in surgery. It reflects a patient's subjective perception of their physical, social and psychological wellbeing. It also helps to analyze the equilibrium between disease control and the adverse effects of treatment. Unfortunately, reports on the impact of an open abdomen wound and its treatment on QOL are scanty in the medical literature. This also contributes to the hesitancy of using the OA method as a reliable modality to accommodate damage control resuscitation.

A study from Orlando, Florida, United States, examined the long-term physical, mental, and functional consequences of abdominal decompression for intra-abdominal hypertension. It reports there are significant initial reductions in the physical, social and emotional health of the patient; however, the majority of patients do return to meaningful and productive lifestyles eventually [1]. Hence, the use of OA for the treatment of intraabdominal trauma should not be seen as diminishing QOL in trauma patients. This study aims to determine the quality of life of trauma patients, who underwent damage control surgery using either the open abdomen or the closed abdomen method, within 6 months to 12 months in the postoperative period.

Materials and Methodology

This study was conducted as a single-center prospective study in Hospital Sultanah Aminah Johor Bahru (HSAJB), a designated level 1 trauma center in Malaysia. After obtaining approval from the Ethics Committee and Institutional Review Board (IRB) of the University Kebangsaan Malaysia (Project Code: FF-2019-177) and the Malaysian Research Ethics Committee (NMRR-18-3601-44898), patients were selected from the trauma registry of the Trauma Unit, HSAJB, with an inclusion criterion of all patients who underwent laparotomy for blunt or penetrating abdominal injury from January 2018 to May 2019, within the age range of 18 years to 65 years with no significant comorbidities. These patients were divided into 2 arms: Open Abdomen (OA) arm and Closed Abdomen (CA) arm. Those with an associated head injury with neurological impairment or those who had an initial phase of surgery done outside our hospital and were then referred for further management and patients having limb injuries severe enough to result in an amputation were excluded from this study. Patients were assessed within a postoperative 6 month to 12 month period.

Open abdomen was defined as the immediate application of modified VAC dressing to laparostomy wound post-primary exploratory laparotomy for DCS, where patients were subjected to definitive surgery and delayed closure of the abdomen after 24 h to 48 h of Intensive Care Unit (ICU) optimization of physiological parameters. Closed abdomen was defined as the immediate closure of the abdomen post-primary exploratory laparotomy for DCS, and this group was taken as the control group. Patients' contact information was obtained from the trauma registry. Data on post-op outcomes and complications as well as length of ICU and total hospital stay were also taken from the trauma registry.

Patients were called *via* phone beforehand and, if they consented to be recruited after understanding the patient information sheet, were given the option of a recorded phone interview or a written one. Those recruited were required to answer a RAND-36 Quality of Life (QOL) questionnaire in either English or Bahasa Malaysia (validated from a previous similar Malaysian study) *via* phone or to present themselves for a single follow-up in the surgical outpatient

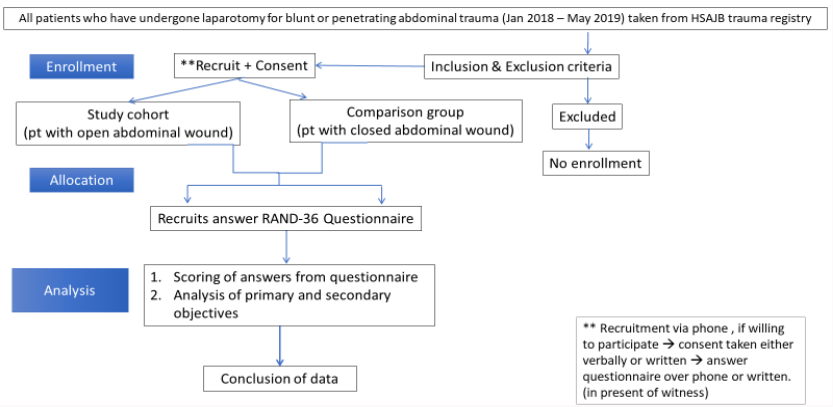

Figure 1: Flow of patient selection and recruitment for the study.

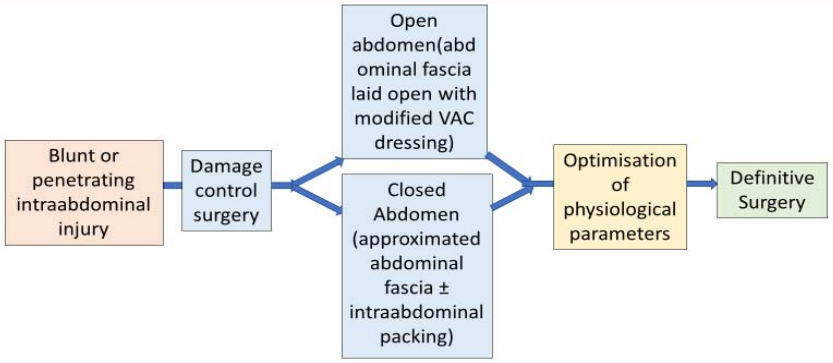

Figure 2: Management for intraabdominal injury in Hospital Sultanah Aminah JB.

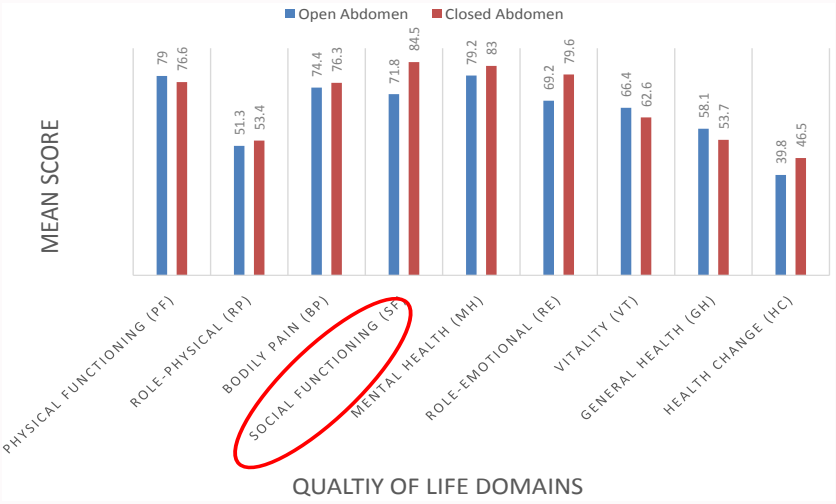

Chart 1: Comparison of the mean score for each QOL domain between the open abdomen and the closed abdomen groups.

clinic. Scoring of the questionnaire based on the RAND-36 scoring system has eight scaled scores; the scores are weighted sums of the questions in each section (Figure 1). Scores range from 0 to 100; lower scores = more disability, higher scores = less disability. Rand-36 QOL questionnaire encompasses 9 domains of QOL aspects, namely:

- Physical functioning
- Physical role functioning
- Bodily pain
- General health perceptions
- Energy/vitality
- Social role functioning
- Emotional role functioning
- Mental health
- Health change

*Health status scale is shown in Table 1 [6].

Postoperative complications, that is, the development of enterocutaneous fistula, relaparotomy secondary to Intraabdominal Hypertension (IAH), chronic pain (persistent PS>5/10 after 3 months post-op) and incidence of incisional hernia post-laparotomy, were also analyzed in this study.

Statistical analysis

Statistical analyses were conducted using the Statistical Package for Social Sciences, version 22.0. The results were expressed as mean and Standard Deviation (SD) for continuous variables. Continuous variables were compared using the independent sample t test. Categorical variables were described using odds ratio and 95% Confidence Interval (CI). Categorical variables were compared using the chi-square test as appropriate. $p<0.05$ was considered as statistically significant.

Results

A total of 63 patients were recruited for this study, 27 in the Open Abdomen (OA) group and 36 in the Closed Abdomen (CA) group. The majority were male (77.8%) and Malay (47.6%) with a mean age of 32 years. Mean Injury Severity Scores (ISS) for both the open and closed abdomen groups are within 12 to 14. Other demographic data, duration of ICU stay, and total hospitalization length are shown in Table 2. There is a significantly longer length of stay in ICU for the OA group compared to the CA group ($p<0.05$). However, there were no significant differences in the total duration of hospital stay overall for both groups.

There were 2 cases reported to develop incisional hernia from the OA group within 1-year post-surgery. One case of enterocutaneous fistula was reported in the OA group, which developed within 2 weeks of primary surgery. However, both complications were not

Table 1: Rand-36 QOL status scales*.

Concept	Meaning of Scale
Physical Functioning	Performs all types of physical activities including the most vigorous without limitations caused by health
Role-physical	No problems with work or other daily activities as a result of physical health
Bodily Pain	No pain or limitations caused by pain
General Health	Evaluates personal health as excellent
Energy/Vitality	Feels full of pep and energy all the time
Social Functioning	Performs normal social activities without interference caused by physical or emotional problems
Role-emotional	No problems with work or other daily activities as a result of emotional problems
Mental Health	Feels peaceful, happy and calm all the time

*Definitions taken from Ware et al. 2000 [9].

Table 2: Patients' sociodemographic details, ISS score, length of ICU stays, and total hospital stay.

Patients' Characteristics		Number of Patients (N=63)	Percentage of Frequency n (%)
Gender	Male	49	-77.8
	Female	14	-22.2
Age	Mean ± SD	32.6 ± 12.3	
	18–25	20	-31.7
	26–35	22	-34.9
	36–45	12	-19
	46–55	5	-7.9
	55–65	4	-6.3
Race	Malay	30	-47.6
	Chinese	19	-30.2
	Indian	13	-20.6
	Others	1	-1.6
ISS score		Mean ± SD	p Value
	Open abdomen	14.11 ± 4.81	0.123
	Closed abdomen	12.44 ± 3.64	
Duration of ICU stay		Mean ± SD	p Value
	Open abdomen	6.00 ± 2.48	**<0.05**
	Closed abdomen	0.75 ± 1.75	
Length of hospital stay		Mean ± SD	p Value
	Open abdomen	14.89 ± 6.97	0.119
	Closed abdomen	12.56 ± 4.75	

statistically significant compared to the CA group. There were, however, a significant number of patients requiring relaparotomy due to IAH in the CA group compared to the OA group. (p: 0.044). None were reported in the OA group. There was no significant difference in the development of chronic pain between both groups (p: 0.056). Details are as shown in Table 3.

Based on the RAND-36 scoring system, data on the 9 major Quality of Life (QOL) domains were analyzed using an independent t-test. There is a significant impact on social functioning domain on the OA group compared to the CA group (p: 0.016). However, there are no other significant differences in QOL, especially in both physical and mental domains between both groups. Details are as shown in Table 4 and chart 1.

Discussion

We report the results of a prospective single-center cohort study regarding the impact of an open abdominal wound on the quality of life of trauma patients. Reports state that although there are prior compelling reductions in physical, social, and emotional health, patients requiring abdominal decompression who survive their initial injuries or illness can return to meaningful and productive lifestyles once abdominal fascial closure is achieved [2,4]. However, we do not possess local data on our current population to make the definitive decision to embrace the concept of abdominal decompression or open abdominal wound as an effective damage control surgery measure. We are hoping the outcome of this study will help assure our local surgeons that open abdominal wound improves immediate post-operative outcomes and does not truncate a patient's quality of life here after.

A total of 27 patients who had open abdominal wounds and 36 patients who had closed abdominal wound consented to be recruited. Abdominal decompression or OA is usually adapted as a modality of damage control surgery for hemodynamically unstable patients with multiorgan injuries. Eighty percent of our patients were from

Table 3: Comparison of postoperative complications between the open abdomen and the closed abdomen groups.

Postoperative Complications	Open Abdomen n (%)	Closed Abdomen n (%)	P Value (Chi-Square)
Enterocutaneous fistula			
Yes	1 (3.7)	**0 (0)**	0.244
No	26 (96.2)	36 (100)	
Intraabdominal hypertension requiring relaparotomy			
Yes	0 (0)	**5 (13.8)**	**0.044**
No	27 (100)	31 (86.1)	
Chronic pain *(pain score >5/10 @ 3months postoperative)*			
Yes	13 (48.1)	9 (25.0)	0.056
No	14 (51.8)	27 (75.0)	
Incisional hernia			
Yes	2 (7.4)	0 (0)	0.097
No	25 (92.5)	36 (100)	

Table 4: Health-related quality of life scores for the open abdomen group *vs*. the closed abdomen group.

QOL Domain	Open Abdomen (n=27) Mean score ± SD	Closed Abdomen (n=36) Mean score ± SD	P Value (Independent T Test)
Physical functioning (PF)	79.0 ± 17.9	76.6 ± 17.6	0.596
Role-physical (RP)	51.3 ± 36.0	53.4 ± 32.8	0.812
Bodily pain (BP)	74.4 ± 19.9	76.3 ± 20.3	0.717
Social functioning (SF)	71.8 ± 22.6	84.5 ± 17.9	**0.016**
Mental health (MH)	79.2 ± 14.2	83.0 ± 9.2	0.213
Role-emotional (RE)	69.2 ± 33.2	79.6 ± 30.1	0.198
Vitality (VT)	66.4 ± 19.9	62.6 ± 12.8	0.357
General health (GH)	58.1 ± 20.5	53.7 ± 18.3	0.371
Health change (HC)	39.8 ± 18.6	46.5 ± 21.6	0.202

young to middle adulthood (18 years to 40 years) likely because the majority of blunt intraabdominal injuries are secondary to road traffic accidents and the working population is made up mostly of this age group. The smaller sample size in the OA group is because most OA treatment patients with a higher ISS succumbed due to other grievous associated injuries. The Injury Severity Score (ISS) standardizes the severity of traumatic injury based on the worst injury of 6 body systems. Patients recruited in both arms were surprisingly matched in terms of ISS scoring (mean ± SD, OA: 14.11 ± 4.81; CA: 12.44 ± 3.64). Patients were also recruited within the 6 month to 12 month postoperative period to avoid any recall bias.

There was a significant prolonged ICU stay in the OA group ($p<0.05$) likely because all patients with an open abdominal wound were kept ventilated and sedated throughout the damage control resuscitation. These patients were tentatively taken back to OT for definitive surgery and attempted closure of the abdomen within 48 h to 72 h post-primary laparotomy. Many from this group underwent multiple abdominal surgeries before achieving complete closure of the abdomen, which resulted in longer ICU stays compared to the CA group. However, we observed that there was no statistically significant difference in the total hospitalization period for both groups ($p=0.119$).

From our study, only 1 patient (3%) from our OA group developed an enterocutaneous fistula within 1 week of his initial laparotomy. He suffered from deep dehiscence of his midline wound and was reported to have a cocoon abdomen upon relaparotomy with a high output fistula as a complication of the previous laparostomy. He underwent a third surgery for excision of fistula with delayed fascial closure subsequently. There were 2 patients (7%) who suffered from incisional hernia from the OA group. These patients did not suffer from any further complications of the hernia during their follow-up examination and were not keen on any further surgical intervention to repair the defect. No enterocutaneous fistula or incisional hernia was reported in the CA group.

There was a significant difference in the rate of relaparotomy secondary to the development of Intraabdominal Hypertension (IAH) in the CA group ($p=0.044$). IAP is measured indirectly using the bladder to obtain the inferred measurement via an indwelling urinary catheter. Bladder pressure is expressed in mmHg. A reading of >15 mmHg was taken as IAH, and IAP>20 mmHg was taken as abdominal compartment syndrome. A total of 5 patients (13.8%) were subjected to an urgent relaparotomy within 24 h in view of IAH causing systemic disruption (renal, hepatic and circulatory dysfunction). This sequential effect of IAH leading to Abdominal Compartment Syndrome (ACS) has been described by Hunt et al. [7] and numerous other papers. None of the OA groups developed IAH as expected due to the absence of fascial closure allowing the unlimited expansion of viscera during aggressive damage control resuscitation [8].

Chronic pain was defined as a persistent pain score of >5/10 after a 3-month postoperative period over the midline wound site. Surprisingly, there were no significant differences between both groups ($p=0.056$).

After scoring patients for QOL based on the RAND-36 questionnaire scoring system, we observed that there was only one domain that showed a significant difference in the impact of OA wound in trauma patients. Patients complained of a significant decline in social functioning postoperatively at 6 months to 12 months. This event may be related to other confounding factors in the cohort and may not be a direct result of the OA treatment itself. Cheatham et al. [4] stated that patients who underwent abdominal decompression surgery and received delayed abdominal wall closure usually had challenges indulging in social activity in view of difficulty conforming to apparel change and refraining from alcohol consumption. A significantly longer ICU stay is also known to cause a reduction in the quality of life and social functioning. Apparently, patients who have been exposed to a long bed rest tend to prolong this habit even after leaving the ICU or hospital and even without any physical or emotional issues [6,9]. There was no other significant impact on the physical and emotional aspects regarding patients' general QOL. However, this study revealed there was no difference in physical and mental functioning between the two arms, as both domains are among the key important factors for a person's wellbeing.

Overall, this study has helped to provide us with useful information on the long-term effects of an open abdominal wound on the QOL in trauma patients. It proves that despite the concern about using open abdominal wound for DCS, there are no immediate significant morbidities to the patient postoperatively. It is also proven to markedly reduce the incidence of IAH in trauma patients after laparotomy, which has a formidable postoperative complication with a grim multisystem derangement. Patients are also proven to be able to return to leading meaningful lives postoperatively without extreme difficulties.

Amongst the limitations of our study, our small sample size could have provided better information on patient outcomes. A lack of information on hospitalization fees also caused our inability to make a hospital cost analysis, which would have helped shape future treatment policies. Our study does not exclude other associated injuries, such as thoracic injuries or limb injuries not requiring amputation; this may also influence the scoring of QOL in general.

This is the first study that explores the QOL in our local trauma population. However, further studies can be conducted with a larger sample size involving multiple centers to provide more information on this therapy.

Conclusion

An open abdominal wound does not reduce the overall quality of life in trauma patients. However, a patient's social functioning in the OA group might be affected. Patients who had an open abdominal wound had a longer ICU stay. However, there are no significant differences in postoperative outcomes or total hospitalization stay. An open abdominal wound can be adapted as an efficient modality for damage control surgery for intraabdominal injuries.

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