



## The Outcome of Damage Control Surgery at Sultan Qaboos University Hospital

Abri MA<sup>1\*</sup>, Snani SA<sup>1</sup>, Almayahi J<sup>2</sup>, Sharqi AA<sup>3</sup> and Qadhi HA<sup>4</sup>

<sup>1</sup>General Surgery Program, University of British Columbia, Canada

<sup>2</sup>College of Medicine and Health Science, Muscat, Oman

<sup>3</sup>General Surgery Program, Oman Medical Specialty Board, Muscat, Oman

<sup>4</sup>Department of Surgery, Sultan Qaboos University Hospital, Muscat, Oman

### Abstract

**Background:** Damage Control Surgery (DCS) is a type of surgery that is used to save trauma patients who are hemodynamically abnormal and had abdominal trauma. It is used to stabilize the physiology of the body rather than anatomy to prevent the patients from the lethal triad of trauma.

**Methods:** This is a retrospective cohort study was conducted at the department of surgery at Sultan Qaboos University Hospital (SQUH). This study included all patients who underwent damage control surgery for trauma from January 01<sup>st</sup>, 2014 to September 17<sup>th</sup>, 2019. Data was collected from the Hospital information system (Track care) and was analyzed by SPSS software version 23.

**Results:** There was a total number 40 patients who underwent DCS and enrolled in this study. The maximum number of DCS was in 2018 with 10 cases followed by 2017 with 9 cases. The correlation between the mechanism of injury duration of shifting from emergency room to operation theatre was statically significant. The median of time needs to complete close of the abdomen was one day.

**Conclusion:** There was a high mortality rate among DCS patients at SQUH. However, there was no correlation between the duration of shifting patient from ER to OT and duration of surgery with the mortality rate. However, the sample size was small and we only included one trauma center, so further study is needed to investigate the outcome of DCS in Oman.

**Keywords:** Damage control surgery; Trauma; Mortality

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#### \*Correspondence:

Mohammed AL Abri, General Surgery Program, University of British Columbia, Canada,

E-mail: abri.mohd95@gmail.com

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### Introduction

Damage Control Surgery (DCS) is a concept of abbreviated laparotomy. It's mainly used for patients who have sustained life-threatening injury and are hemodynamically abnormal. It is done to overcome the further trauma complication of a lethal triad which includes hypothermia (below 35 degrees), acidosis which results in decreased blood flow to the tissue and lack of oxygen, and lastly coagulopathy [1]. In addition to that, uncontrolled bleeding becomes the most cause of death in trauma patient and it represents 40% of trauma death [2]. So, the main purpose of DCS is mainly to achieve hemostasis by stop hemorrhage and prevent contamination. Furthermore, DCS importance appears in minimizing the time of operation (up to 90 min), prevent any irreversible physiological harm, provide good care in the intensive care unit and doing relook laparotomy if required [3].

The indications for DCS are based not only upon the type of traumatic injury but also include the patient's physiologic response to the injury. The physiologic response can be determined by vital signs and mental status [3]. There is multiple well recognize indications for DCS including; (1) Severe degree of physiological harm like hypothermia, shock and coagulation. (2) Conventional methods are not useful to control bleeding. (3) If the patient requires a large number of blood package and other blood products. (4) Identifying an injury pattern, for example huge disturbance of the pancreases, duodenum. (5) Multiple stages required to reconstruct the abdomen like in case of visceral edema or compartment syndrome [4].

DCS includes five phases of care. Phase zero is the prehospital and initial evaluation phases where initial evaluation and management in the emergency department as per ATLS protocol [4,5]. Phases one focus on stopping hemorrhage, limit contamination, maintain blood flow to the extremities and

vital organs and it should not exceed 90 min [2]. In phase two, ICU care is provided for the patient to monitor and correcting any needs and to provide rewarming and correcting acidosis and coagulopathy [6]. Phase 3 done after 24 h to 48 h and consist of definitive repair of injury and temporary closer of abdomen but this depends on the physiological status of the patient [3]. Phase four is the final phase where abdominal closer is taking place here and it should be done after fully recovery of the patient [5,6].

Damage control surgery showed improvement in both morbidity and mortality rate. The earliest report showed that mortality declined by 66% with damage control surgery compared with other techniques [7]. Another study in Caroline University showed that DCS start in 1993 and the improvement in mortality in patients with vascular damage was seven-fold (from 11% to 77%) [5]. Another study has shown that mortality rates decrease over 66% to 20% by using DCS [8]. However, there was no previous study conducted to look for the incidence and outcome of DCS in Sultanate of Oman so this study is aiming to study DCS and its outcome at Sultan Qaboos University Hospital, Muscat, Oman.

## Methods

### Study design

This is a retrospective cohort study was conducted at the department of surgery at Sultan Qaboos University Hospital (SQUH) as it is considering a major trauma center in Oman. It was ethically approved by the medical research ethical committee at the College of Medicine at Sultan Qaboos University.

### Inclusion criteria and exclusion criteria

This study included all patients who underwent damage control surgery for trauma from January 01<sup>st</sup>, 2014 to September 17<sup>th</sup>, 2019 at SQUH. Those patients who had surgery other than DCS and those who had a delayed laparotomy after admission for clinical deterioration were excluded.

### Data collection

Data was collected from the Hospital information system (Track care). Patients who had trauma in the giving period were reviewed. Only those who had penetrating or blunt trauma and underwent damage control surgery were selected. All patients had standardized data collection including age, gender, mechanism of injury, solid organ injury, number of blood transfusion units needed, time taken to shift to OT and duration of surgery, length of ICU stay and outcome.

### Data analysis

Data were analyzed by SPSS software version 23. The database for the study sample was created. The means and Standard Deviation (SD) of each of the above parameters were calculated. Frequency and Pie charts tables had been used to display percentages for continuous variables and categorized variables. To test the significance of the association between the categorized variables Chi-square test was used and a P-value of 0.05 or less taken as significant with a confidence interval of 95%.

## Results

There were a total number 40 patients who underwent DCS and enrolled in this study. Thirty-six patients were males and 4 were females. The median age was 30 with standard deviation of 12. The maximum number of DCS was in 2018 with 10 cases followed by 2017 with 9 cases as it is shown in Figure 1. The Median of time need

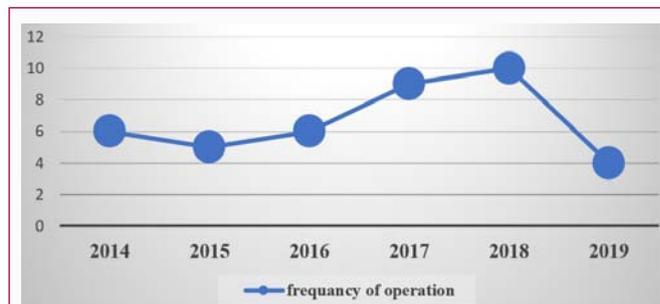


Figure 1: Frequency of damage control surgery per year.

Table 1: Mortality among study population.

Variables	Survive	Not survive	Total
Frequency	20	20	40
Percentage	50%	50%	100%

Table 2: Correlation between mechanism of injure, duration of shifting from emergency room to operation theater and duration of surgery with survival rate.

Variables	Not Survived	Survived	P Value	
Mechanism of injury	Blunt	20	16	0.035
	Penetrating	0	4	
Duration of shifting from ER to OT	≤ 60 minutes	14	9	0.11
	>60 minutes	6	11	
Duration of surgery	≤ 90 minutes	9	11	0.527
	>90 minutes	11	9	

do completely close the abdomen of all survived patient was 1 day with range 0 to 16 days and mean 1.64 days.

Table 1 represents the mortality among the study population. Half of the patient survived after DCS and the other half died. Eleven patients died at operation theater due to abdominal injury and nine of them died in ICU.

Table 2 showing the correlation between the mechanism of injury duration of shifting from emergency room to operation theater and duration of surgery with survival rate and the survival rate. Thirty-six patients had blunt trauma and four had penetrating trauma. Out of the 36 patients, 16 patients only survived after the DCS and all 4 cases of penetrating trauma survived. The P value was significant with value of 0.035. However, upon studying the correlation between the time needed to shift the patient from emergency room to operation theater, the median time was 60 min. There were 23 patients who transferred to OT within 60 min and 17 took longer duration of transfer. In group 1; 14 patient and 6 in the second group did not survived. The p value was not significant. Then patients were grouped into two groups depending on the duration of surgery. Group one; the operation took 90 min or less and group two; the duration was more than 90 min. Twenty patients were in each group. Nine patients in the first group and eleven patients in the second group did not survived. P-value was equal to 0.527 and it is not statistically significant.

## Discussion

Damage control surgery is a type of surgery that is used to save trauma patients who are hemodynamically abnormal and had abdominal trauma. It is used to stabilize the physiology of the body rather than anatomy to prevent the patients from the lethal triad of

trauma [9].

There was a total number of 40 patients who involved in this study and half of them died during or after the DCS with percentage of 50%. However, the rate of mortality is varied from one study to another. A study has been done in Japan for 532 patients who underwent DCS the mortality rate was 59% [10]. Another retrospective cohort study for twelve United States trauma centers showed that among 1,706 patients who underwent DCS, the mortality rate for the entire cohort was 21% [11]. Furthermore, a study has been done in the United States showed that among 346 had DCS the mortality rate was 22.8% [12]. There are multiple reasons that might play a role in the variation of mortality rate including: number of patients included, number of centers included, associated solid organ injury and some of hospitals have operation theater at emergency department which is not the case in our institute.

In regards to the mechanism of injury and survival rate, the analysis showed that survival rate was higher with those who had penetrating injury comparing to blunt injury and it was statically significant. This result agrees with a study done in University of Southern California including 447 patients with 40.8% survival rate among penetrating trauma patients comparing to 24.1% in blunt injury with significant P value 0.004 [13]. Another study at the University of Cape Town for 25 patients underwent DCS which showed survival rate among penetrating trauma patients 90% in comparison to 80% for blunt injury patients [14].

It is important to see the correlation between the duration from emergency to the operating room as any delay in transferring the patients can affect their survival. A study has been done at the University of Miami Miller School of Medicine in Florida showed that delay in transferring the patients more than 10 min increases the risk of mortality by almost threefold [15]. Furthermore, another study stated that "The probability of death increased approximately 1% for every 3 min in the ED" [16]. The results showed that the median of the duration of time to transfer the patient from ER to OT was 60 min which is double of duration needed in the USA as it was 28 min [12]. Another study in the USA showed that the duration was 16 min [15]. However, a study with 243 patients showed that the median was approximately the same as what was found in SQUH (55 min) but this study data collected in 1999 [16]. And this can be explained because of the lack of both prehospital phase (phase 0) which is important in the selection of patients and availability of operation theater at emergency department. However, there was no significant correlation between survival rate and the duration need to transfer the patients from ED to OT.

Previous studies agreed that the operation duration should not exceed 90 min to avoid lethal triad complications which may affect the mortality rate of DCL patients [2]. In this study, the mean operation duration was 92.5 min which agrees to the above-mentioned study. However, there was no significant correlation between the duration of surgery and mortality rate in this study.

Keeping the abdomen open for a long time was associated with an increased chance of developing complications such as intra-abdominal collection [17]. Our study showed that the mean of duration that needs to complete closure of the abdomen was 1.64 days ranged between 0 to 16 days, which is lower than mean in previous studies as it was 2.4 days in South Africa [17]. Other studies in the USA showed that the duration of closure means was 4.19 days [18].

This study has several potentials limitations including small sample size and some missing data since it is a retrospective study. A future study including more trauma centers and larger sample size will be more appropriate to study the outcome of damage control surgery in Oman.

## Conclusion

The presented study focused on the outcome of damage control surgery in Sultan Qaboos University Hospital in Sultanate of Oman. We conclude that there was a high mortality rate among DCS patients. At SQUH Also there was no correlation between the duration of shifting patient from ER to OT and duration of surgery with the mortality rate. However, the sample size was small and we only included one trauma center, so further study is needed to investigate the outcome of DCS in Oman.

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