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Original study

Clinical profile and outcome of damage control laparotomies in a tertiary care centre

Üçüncü basamak bir merkezdeki hasar kontrol cerrahisi uygulanan hastaların klinik profilleri

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ABSTRACT

Trauma is the major cause of death worldwide. Survival of the major trauma victims can be improved by the principles of damage control surgery. The vicious cycle of trauma triad, namely, hypothermia, coagulopathy and acidosis should be intercepted by the quick abbreviated laparotomy and subsequently physiological imbalance is corrected by secondary resuscitation in the surgical intensive care unit. Definite repair can be taken later on. Abdominal compartment syndrome is the most formidable complication. Multidisciplinary team approach is needed to alleviate the physical and psychological trauma of the patient. Objective: To study the clinical profile and outcomes of the patients undergoing damage control laparotomy and to determine the factors responsible of the morbidity and mortality. Also to compare the characteristics of patients undergoing damage control surgery for traumatic as well as non-traumatic patients.

The study was conducted in Department of General Surgery, Himalayan Institute of Medical Sciences, Swami Ram Nagar, Dehradun after approval of institute ethic committee over a period of 18 months. All the patients who underwent damage control for traumatic as well as non-traumatic cases were included in the study. Based on the records from the previous year, 30 patients were recruited for convenient sampling method.

Clinical profile and outcome of 25 traumatic patients and 6 non-traumatic cases were compared. Prothrombin Time and International Normalized Ratio (PT/INR), injury site to Emergency room time and Injury site to operating room time were found to be confounding factors which had a role in predicting mortality.

Keywords: Damage control surgery, trauma triad, hypothermia, coagulopathy, acidosis, abdominal compartment syndrome.

ÖZET

Travma, dünya çapında ölümlerin ana nedenidir. Büyük travma kurbanlarının hayatta kalması, hasar kontrol cerrahisi prensipleriyle azaltılabilir. Travma triadinin kısır döngüsü, yani hipotermi, koagülopati ve asidoz, hızlı kısaltılmış laparotomi ile önlenmeli ve daha sonra fizyolojik dengesizlik, cerrahi yoğun bakım ünitesinde ikincil resüsitasyon ile düzeltilmelidir. Kesin onarım daha sonra yapılabilir. Abdominal kompartman sendromu en zorlu komplikasyonlardan birisidir. Hastanın fiziksel ve psikolojik travmasını hafifletmek için multidisipliner ekip yaklaşımı gereklidir.

Hasar kontrol laparotomisi yapılan hastaların klinik profilini ve sonuçlarını incelemek ve morbidite ve mortaliteden sorumlu faktörleri belirlemektir. Ayrıca travmatik ve travmatik olmayan hastalar için hasar kontrol cerrahisi geçiren hastaların özelliklerini karşılaştırmaktır.

Çalışma, 18 aylık bir süre boyunca enstitü etik kurulunun onayının ardından, Himalaya Tıp Bilimleri Enstitüsü, Swami Ram Nagar, Dehradun Genel Cerrahi Bölümü'nde gerçekleştirildi. Travmatik ve travmatik olmayan vakalar için hasar kontrolü yapılan tüm hastalar çalışmaya alındı. Önceki yıllara ait kayıtlara dayanarak, 30

hasta uygun örnekleme yöntemi için çalışmaya alındı. 25 travmatik hastanın ve 6 travmatik olmayan hastanın klinik profili ve sonuçları karşılaştırıldı.

Protrombin Zamanı ve Uluslararası Normalize Oranı (PT / INR), yaralanma yeri ile Acil servis süresi arasında ve yaralanma yeri ile ameliyathane süresi arasında mortaliteyi öngörmede rol oynayan problemler olarak bulunmuştur.

Anahtar kelimeler: Hasra kontrol cerrahisi, travma triadı, hipotermi, koagülopati, asidoz, abdominal kompartmant sendromu.

INTRODUCTION

The bloody lethal triad of hypothermia, acidosis, and coagulopathy has been the nemesis of trauma surgeons for decades. Many advances in the field of trauma have evolved around prevention and treatment of this clinical scenario. One useful technique is damage control laparotomy (DCL). DCL has 3 stages, an abbreviated initial operative procedure with temporary abdominal closure (TAC); continued resuscitation and management of physiologic and acid–base derangements, and definitive treatment and closure (1).

The first stage in DCL is control of haemorrhage and contamination followed by use of a TAC strategy (2). The optimal TAC strategy should prevent evisceration, evacuate fluid, allow access to the abdominal cavity, and allow for expansion in order to prevent abdominal compartment syndrome (ACS). The second stage of DCL involves continuation of resuscitation, which should include judicious fluid administration with aggressive correction of coagulopathy, acidosis, and hypothermia. Additional management may include paralysis, early enteral nutrition, and diuresis. Lastly, once normal physiology has been restored, the patient should return to the operating room for definitive repair of injuries, followed by abdominal wall closure with reconstruc-tion if possible in the same or in subsequent operative interventions (3).

DCL has been associated with improved outcomes and decreased mortality in severely injured trauma patients (4). Because of this, DCL indications have been expanded to include abdominal sepsis, ACS, and prolonged or extensive elective surgery. This is a review of the current literature on DCL including recommendations regarding the indications for DCL, techniques of TAC, intensive care unit (ICU) management, and abdominal closure with reconstruction (5).

To our knowledge no randomized controlled trials (RCT) exist for the use of DCL, although there are many retrospective reviews and prospective observational trials demonstrating improved outcomes in both trauma and acute care surgery populations (6).

In surgery, “damage control” refers to those manoeuvres designed to ensure patient survival (7). Although first described formally in the civilian trauma population, DCS has been used in the military to facilitate prompt surgical control of bleeding and contamination and early evacuation of injured soldiers, with resultant improvement in survival rates (8,9). The concept of abbreviated surgery aimed primarily at arresting bleeding was first introduced by Pringle in 1908 (10). Halsted and Schroeder individually reported their success at arresting bleeding following liver trauma by packing the liver. In 1913 Halsted described modifications to the then well-established practice of packing (11).

DCS relies on optimal resources for pre-hospital in-transit care, intra-operative treatment, interval stabilization and post-operative care (12). Most studies in literature describe outcomes of DCS in resource-rich healthcare settings (13). However, there is paucity of literature describing the application and outcomes of damage control surgery in resource poor countries (14). The spectrum of injury and outcomes of trauma care in resource-poor settings are affected by several barriers including limited en-route resuscitation, lack of efficient transport, limited resuscitation resources in the trauma bay, increased time to assemble operating teams and limited resources for intensive care before the take-back operation (15). Hence, the presentation and operative care of patients treated with DCS in these settings are expected to be different from experiences reported in resource-rich environments (16).

The principles of damage control surgery were first described by Stone et al in 1983 in an attempt to reduce mortality in exsanguinating patients with coagulopathy (17). They observed a 35% mortality rate in comparison to the 98% mortality rate when using traditional principles. The term ‘damage control surgery’ was coined by Rotondo and Schwab; they outlined the three stage approach to patients with abdominal trauma, in which re-operation occurs after the correction of physiological parameters (18).

Damage control surgery is aimed at restoring normal physiology over restoring normal anatomy in the unstable, trauma patient. The aim of this strategy is to facilitate surgical control of haemorrhage and contamination, the stabilisation of potentially fatal problems at first look laparotomy, with secondary resuscitation followed by scheduled definitive surgery (12).

MATERIAL AND METHOD

The present study was conducted in the Department of General Surgery, SRHU, Swami Ram Nagar, Dehradun, over a period of 18 months. All the patients with abdominal trauma who underwent damage control laparotomy in our hospital were included after obtaining written informed consent and ethical clearance certificate from ethics committee. Also the clinical profile and outcome of damage control surgery in non-traumatic cases was compared.

Type of study

Descriptive study

Based on the previous hospital records a convenient sample size of 25 patients was taken.

Inclusion criterias

All patients with blunt/penetrating trauma abdomen and patients who underwent staged laparotomy with a decision of planned re-laparotomy in both traumatic as well as non-traumatic patients. Resuscitation by correction of hypoperfusion, hypothermia, metabolic correction and coagulapathy.Definite repair with planned re-laparotomy.

Exclusion criterias

Abdominal trauma managed conservatively and the patients who underwent single stage laparotomy.

A detailed history and physical examination was recorded using the investigator designed working proforma of damage control laparotomy.

Study Protocol

Patients who came to the Emergency department with history of trauma abdomen were included who fit into the damage control criteria.

A. Staged laparotomy with a decision of planned re-laparotomy.
   - Resuscitation by correction of hypoperfusion, hypothermia, metabolic correction and coagulopathy.
   - Definitive repair with planned re-laparotomy.
   - Pre-treatment Work-up consisted of:
     - Complete history and physical examination
     - Routine blood counts, liver function tests and creatinine
     - Coagulation profile
     - Acid blood gas
     - Other imaging studies (Radiology, USG whole abdomen, CECT abdomen)
   - Intraoperative findings of the patients undergoing damage control laparotomy.
   - Procedure done: packing and temporary abdominal closure and ileostomy / colostomy
   - Resuscitation adopted

B. Planned second stage laparotomy
   a. Intraoperative findings
   b. Procedure done

C. Re-planned third stage laparotomy if any
   a. Intraoperative findings
   b. Procedure done

D. Outcome
   a. Morbidity
   b. Mortality

Data management and statistical analysis

Microsoft Excel was used for analysis. The data thus collected was subjected to descriptive statistical analysis and was shown in terms of tables, graphs and pie charts. Quantitative data will be represented in form of mean± standard deviation.

Unpaired 't' test was used to find the compare the characteristic between the mortality and survival group. Chi square test was used to find association of different variables with mortality.

RESULTS

The present study of was carried out in Himalayan Institute of Medical Sciences, Swami Ram Nagar, Dehradun.During the 18 months period, a total of 1753 trauma patients were admitted to our center. Of these approximately 387 (22.07%) had abdominal trauma and out of these approximately 223 (57.62%) underwent surgery. Of which 25 (11.21%) patients underwent DCS. Principles of DCS were applied for 6 patients undergoing surgery undergoing surgery for non-traumatic etiology. The mean age of presentation was 29.44 ± 11.43for traumatic and for non-traumatic. The most common age group involved in the traumatic cases was 21-30 years which had 9 (36%) patients closely followed up 11-20 which had 8 (32%) patients. Whereas the age distribution of the non-traumatic was not that specific and was widely distributed between 11 to 80 years. Out of the 25 cases of trauma included in the study, males constituted about 88% (n=22) of the total sample size, whereas females accounted for 12% (n=3) of the total cases. In non-traumatic cases females accounted for 33% (n=2) of the total sample size whereas males accounted for 67% (n=4). Most common mode of trauma was RTA in 17 (68%) patients followed by FFH which were 6 (24%). There was one case each for penetrating injury and animal mauling (4% each) (Figure 1 and 2).

Time consumed while managing the patient were compaired. The mean Injury to ER time was 84 ± 32.6. While the minimum and the maximum time required reaching the ER was 30 minutes and 150 minutes respectively. Mainly the delay was due to either transportation or transfer from the other hospital. The mean ER to OR time was 124.8 ± 23.34. While the minimum and the maximum time required was 90 minutes and 160 minutes. Mainly the delay was due to the investigations. Then mean injury to OR time was 208 ± 37.02. While the maximum and the minimum time was 160 minutes and 270 minutes. Operative time for managing the trauma cases was 141.6 ± 31.83. The minimum time was 90 minutes and 220 minutes was the maximum time taken.

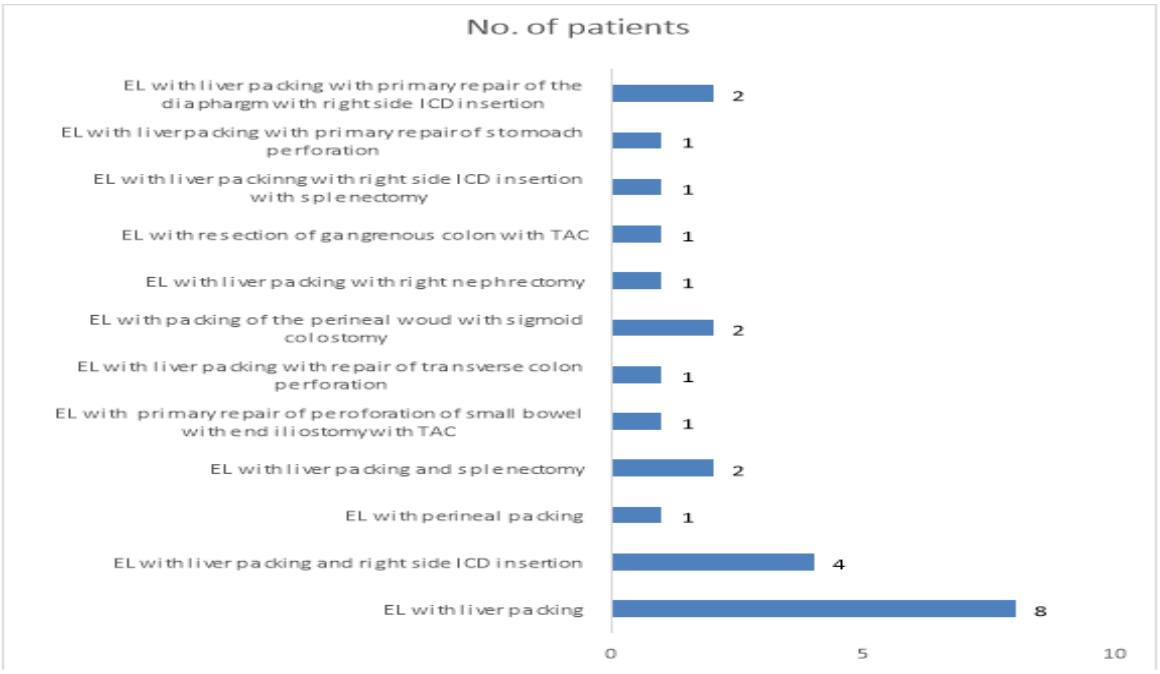

Figure 1: Type of surgeries performed in traumatic cases who underwent DCS (n=25).

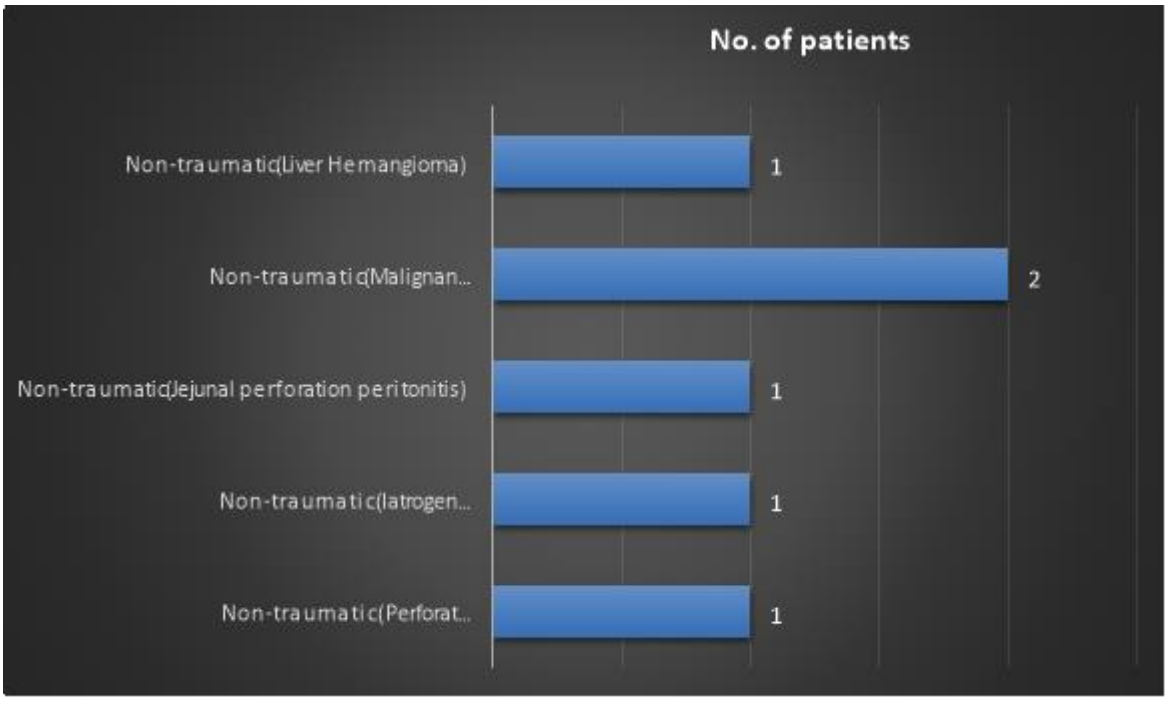

Figure 2: Type of surgeries performed in non-traumatic cases who underwent DCS (n=6).

Traumatic patients were mostly presented to the EMR with pain abdomen (100%) while 16 (64%) patients and 24 (96%) patients had abdominal distension as their presenting symptom. Mostly the patients presenting to the EMR had had tachycardia (68%) while 6 (24%) patients had PR <100 and 2 (8%) patients had non-recordable PR.The SBP was non-recordable in 3(12%) patients while 12 (48%) had hypotension and 10 (40%) were normotensive. Mostly the patient included had GCS in between 13-15, only 3 (12%) cases had GCS of 9-12.Temperature which was recorded using axillary temperature. 15 (60%) patients out of the total 25 had hypothermia (<36^{o}C), while 10 patients had normal temperature (Table 1-3).

FAST, CT, X-ray chest, USG whole abdomen were the main radiological investigations chosen for diagnosis of the patients with abdominal trauma. Blood

investigations including Hb, PCV, platelets, INR, serum creatinine and acid blood gas were sent at the time of arrival in EMR.

In the traumatic patients the ratio of requirement of PRBC: FFP was 2:3. While in non-traumatic patients it was 1:1.37. The mean PRBC transfusion was 3.4 ± 1.44 while in non-traumatic 5 ± 2.44 was the mean unit transfusion of FFP and 3.66 ± 2.13 in the non-traumatic group. Different patients required different amount of PRBC ranging from 1 to 7 units and FFP according to the deranged coagulation profile ranging from 2-8, according to their injury.

On the basis of OT findings, it was found that isolated solid organ injury was the most common injury and also the most common organ injured was liver followed by spleen and thorax. Most liver injuries were Grade-III and IV. Most of the splenic injury was also Grade –III and IV. Spleen was managed by splenectomy and liver by packing. Diaphragmatic injury was noted in 2 patients for which primary repair were done with ICD placement mostly on right side.

Out of the 25 patients with trauma, EL with liver packing (32%) was found to be the most common procedure performed which was followed up by EL with liver packing with Right ICD insertion (16%). These patients were the most difficult to manage as there was prolonged duration of operation seen in them. EL with perianal packing was done because of diffuse peritoneal oozing. There were no similar surgeries carried out for non-traumatic causes. DCS for malignancies were done in 2 cases out of the 6 which for done for Right RCC and CA prostate.

Table 1: Comparison of characteristics between mortality and survival group.

		Total	Survival (n = 12)	Mortality (n=13)	p value
SOCIO DEMOGRAPHIC AND INJURY CHARACTERISTICS					
Age		29.44 ± 11.43	29 ±14.37	29.9 ± 6.92	0.8458
Gender	Male	22	13	9	
	Female	3	0	3	
Transfer	Yes	5	3	2	
	No	20	10	10	
Injury type	Blunt	24	12	12	
	Penetrating	1	1	0	
Mode of injury	RTA	17	8	9	
	FFH	6	4	2	
	Penetrating	1	1	0	
	Animal Mauling	1	0	1	
Injury-ER time(min)		84 ± 32.86	64.61 ± 23.07	105 ± 28.72	0.0007
ED CHARACTERISTICS					
Hypotensive	Yes	16	7	9	
	No	9	6	3	
Tachycardia	Yes	18	8	10	
	No	7	5	2	
GCS	3.-8	0	0	0	
	9-12	6	3	3	
	12-15	19	10	9	
ISS		27.1 ± 8.23	26.83 ± 7.06	27.46 ±2.68	0.531
pH		7.31 ± 0.06	7.33 ± 0.05	7.29 ± 0.06	0.824
INR		1.61 ± 0.37	1.4 ± 0.25	1.82 ± 0.35	0.0021
Temperature		35.86 ± 0.65	36.07 ± 0.64	35.63 ± 5.9	0.7913
ER to OR(min)		124.8 ± 23.34	126.15 ± 22.71	123.3 ± 23.92	0.762
Injury to OR		208 ± 37.02	190.77 ± 33.61	225.83 ± 34.75	0.0174
Operative time (min)		141.6 ± 31.83	130.77 ± 24.95	153.3 ± 34.23	0.712
Blood transfusion	PRBCs	3.4± 1.44	3.46 ± 1.21	3.33 ± 1.65	0.823
	FFPs	5.28 ± 1.58	4.92 ± 1.49	5.67 ± 1.6	0.237
Average hospital stay		7.56 ± 4.8	11.07 ± 4.18	3.75 ± 1.16	0.001

* Unpaired 't' test

Other causes for which DCS was attempted was hemangioma of liver which was initially thought to be a hydatid cyst but intra-operatively was found to be hemangioma, packing was the method used. Other causes were perforated posterior duodenal ulcer, iatrogenic, and also for diffuse peritoneal bleed in a case of jejunal perforation peritonitis which was managed by packing of the bilateral paracolic gutter.

Extra abdomino-thoracic injuries were noted in approximately 16 patients with trauma out of 25. Most common extra abdomino-thoracic injury noted was upper limb injuries in 7, lower limb injuries were 6, head injuries were seen in 2 patients and facial injuries were seen in 1.

About 6 patients required surgeries for extra abdomino-thoracic injuries. 3 were performed for lower limb injuries (femur fracture) which were initially stabilized using casts/splints in the EMR department and 2 patients underwent surgery for upper limb (humerus) and 1 patient underwent plastic surgery for repair of the lacerations from plastic surgery side. While none of the head injury patients required surgery and were managed conservatively.

"Lethal triad" consisted of acidosis, hypothermia and coagulopathy. Patients meeting the triad were 9(36%) out of 25 trauma patients. Out of which 6 (66.7%) had mortality in cases of trauma. Only 1 (16.7%) out of 6 patients in the non-traumatic patients who underwent DCS met the criteria of lethal triad but there was no mortality.

The parameters noted were temperature, pH and ABG for metabolic acidosis.

Two major methods used in damage control surgery were, packing and and TAC. To control the ongoing hemorrhage from the liver, packing was used in 23 patients in traumatic patients andin 5 non-traumatic patients also packing was used to control ongoing haemorrhage for various reasons. TAC was the other method used in 2 cases in traumatic and 1 case of non-traumatic in cases where there was bowel edema and and were at high risk of developing ACS, to prevent that Bagota's bag was used for TAC and the abdomen was closed in subsequent surgeries.

Out of 25 patients, 24 had complications either systemic or local. Most common morbidity was AKI which was seen in almost 11 (44%) patients followed by SSI in 5 (20%) patients. Other complications were septic shock (12%), AKI with SSI (8%), ARDS (8%) and Septicemia (4%).

Out of 25 patients who underwent trauama who underwent DCS, 12(48%) patients died whereas there was survival of 13(52%) patients.

75% of the patients died because of AKI and 25% patients died because of septic shock in patients with trauma. Almost all the patients died in ICU. None of the patient died in operating room. On the other hand there was no mortality seen in the patient who underwent DCS in the non-traumatic cases.

Table 2: Factors associated with mortality in traumatic patients who underwent DCS (n=25).

Factors associated with mortality		Total no. patients	Died	Survival	p value χ^2
Age	<30 years	17	5	12	P= .006 χ^2 =7.35
	>30 years	8	7	1	
Pulse	<100/min	6	2	4	P=0.709 χ^2 =0.69
	>100/min	17	9	8	
	NR	2	1	1	
SBP	<90mmHg	9	3	6	P=0.195 χ^2 =3.361
	>90mmHg	10	7	3	
	NR	4	3	1	
Difficulty in breathing	Present	16	8	8	P = 0.789 χ^2 =0.071
	Absent	9	4	5	
Coagulopathy	Present	20	10	10	P = 0.068 χ^2 =0.160
	Absent	5	2	3	
Hypothermia	Present	15	10	5	P =0.022 χ^2 = 5.235
	Absent	10	2	8	
Acidosis	Present	16	8	8	P =0.789 χ^2 =0.071
	Absent	9	4	5	
Lethal Triad	Present	9	6	3	P=0.161 χ^2 =1.963
	Absent	16	6	10	

Table 3: Comparison between characteristics and outcome of traumatic and non-traumatic patients who underwent DCS.

Characteristics		Traumatic (n=25	Non-traumatic (n=6)	p value
Age	11-20	8	1	0.061
	21-30	9	2	
	31-40	4	0	
	41-50	2	0	
	51-60	2	0	
	61-70	0	2	
	71-80	0	1	
Sex	Male	22	4	0.240
	Female	3	2	
Hypotension SBP <90 mmHg	Yes	15	2	0.2381
	No	10	4	
Tachycardia	<100/min	8	3	0.4079
	>100/min	17	3	
INR		1.61 ± 0.37	1.46 ± 0.22	0.352
Temp		35.86 ± 0.65	36.53 ± 0.58	0.0283
pH		7.31 ± 0.06	7.33 ± 0.3	0.748
Hb		8.69 ± 1.43	11.63 ± 2.2	0.0003
Blood transfusion	PRBC	3.4 ± 1.44	5 ± 2.44	0.422
	FFP	5.28 ± 1.58	3.66 ± 2.13	0.0435
Outcome	Mortality	12	0	0.030
	Survival	13	6	
Hospital stay (days)		7.56 ± 4.8	17.16 ± 10.88	
Lethal triad	Present	8	1	0.457
	Absent	17	5	

DCS in traumatic cases had 52% success while this surgery showed 100% results in 6 patients who underwent DCS. Better Outcome of DCS in non-traumatic cases were mainly attributed to mostly normal parameters and also surgery being conducted in a controlled setting.

DISCUSSION

This is a descriptive study conducted over a duration of 18 months in Department of Surgery, Himalayan Institute of Medical Sciences, Swami Ram Nagar, Dehradun. This study was done to study the clinical profile and outcomes of damage control surgery in tertiary care center.

The average number of patients undergoing damage control surgery in a high volume trauma center is around 30-33 per year on the other hand our center is not a high volume center and a total of 25 trauma patients were enrolled in this study (104). The patients included in this study were admitted through emergency and were evaluated and underwent damage control laparotomies. Emergency characteristics and also the operative characteristics were noted in the present study. Post-operatively the patients were shifted to ICU care where they were resuscitated and were then planned for definitive surgery. Some of the patients died after the 1st surgery only and the remaining were taken up for re-laparotomy. Causes of mortality were noted and also the morbidities were taken into account. Various other characteristics like the blood transfusion and survival period was also compared to the mortality. Also in this study apart from the traumatic cases, DCS was performed in non-traumatic cases as well and also the results were compared.

Reports of peri-hepatic packing as a damage control technique reappeared in the 1970s and 1980s. Lucas and Ledgerwood reported the use of temporary peri-hepatic packs in 3 of 637 liver injuries treated at Detroit General Hospital in 1976 (105). Whereas in the present study peri-hetatic packing was done in 21 out of the total 25 patients included in the study over a period of 18 months.

Feliciano reported a 90% survival rate in 10 patients with severe liver injuries who were packed in 1981 (106). While the present study says there was survival of 57% patients in a total of 21 patients who underwent peri-hepatic packing.

Schriber et al. concluded that damage control is a staged approach to severely injured patients predicted on treatment priorities. Initially, life-threatening injuries are addressed expediently, and procedures are truncated. Normal physiology is restored in the ICU, and patients subsequently are returned to the operating room for definitive management. This strategy breaks

the bloody vicious cycle and results in improved outcomes. Novel technologies like CAVR and rFVIIa contribute to the effectiveness of damage control (107).

In a similar study which happened in Aga Khan University Hospital, Karachi, Pakistan by Kisat et al. which concluded that out of 258 patients, 47 underwent DCS. 40% patients were transferred from other hospitals. The time between injury and operation was 152 minutes (IQR: 90-330). 55% of the patients survived. (109). The present study shows that out of the 223 abdominal trauma patients, were operated in the past 18 months. Out of them 25 (11.2%) patients underwent DCS. Only 15% were transferred from other hospitals while most of the patients were brought directly to the hospital. The time taken from injury site to operation in the present study was 208 ± 37.02 min (IQR: 160-270) which was found to be significant in the present study ($p = 0.0174$). In our study also 52% survival was seen. Also majority of the patients had a GCS of 13-15 which was also the case in the present study. 32% of the patients had tachycardia while in our study in 72% of the patients' tachycardia was noted when they presented to the EMR. The mean ISS was 24.7(SD: 6.3) whereas in the present study it was 27.1 ± 8.23. Most common associated injury was thoracic injury which was the same case in the present study. In 79% of the patients' acidosis was seen while in the present study 64% (16/25) had acidosis, median pH recorded was 7.31 (IQR 7.25-7.34) while in the present study 7.31 ± 0.06 was the pH of the patient recorded in the EMR ($p = 0.824$). Hypothermia was recorded in 14% patients while in our study; hypothermia was seen in 60% of the patients. 19% of the patients were found to have coagulopathy while in the present study 80% had coagulopathy. Notably the difference was due to the sample size and also because the parameters were not recorded in all the patients. The patient who actually met the clinical triad i.e. the lethal triad amongst the traumatic patients was 9 (36%) out of 25 patients out of which 6 had mortality. Only one (16.7%) patient had mortality out of the 6 patients in the non-traumatic DCS. Liver was found to be the most commonly injured organ similar finding were noted in our study in which isolated liver injury was seen in 8 (32%) patients out of 25. Increased number of PRBC's transfusion had significance ($p < 0.05$) in the traumatic cases where as in the present study it was found to be insignificant ($p = 0.823$). The median length of stay in patients who survived to discharge was 16 days (IQR: 16-29) in the traumatic patients who underwent DCS whereas in the present study it was 7.56 ± 4.8 (IQR: 2-19).

Another study which was conducted in Chungbuk National University College of Medicine and Medical Research Institute, Republic of Korea given by Kim et al. concluded that overall mortality rates were 38.5% (five deaths amongst thirteen patients). The mortality rates of the patients with lethal triad; acidosis, hypothermia and coagulopathy are 83.3% (five deaths among six patients), 60% (three deaths among five patients), 50.0% (five deaths among ten patients), respectively. None of the survival patients were more frequent acute respiratory distress syndrome (60%), multi-organ failure dysfunction (100%) and abdominal compartment syndrome (60%) (110).

The present study concluded that approximately that the mortality was 48% (12 deaths out of 25 patients). The mortality rates of the patients with lethal triad; acidosis, hypothermia and coagulopathy are 83.3% (ten deaths out of thirteen patients), 83.3% (ten deaths amongst thirteen patients), 75% (nine deaths among thirteen patients.), respec-tively. Coagulopathy had occurred with the appearance of multiple factors such as the dilution of coagulation of factors and platelets by fluid resuscitation, decreased total and ionized calcium concentration, hypothermia, the severity of injury, shock and metabolic acidosis. Stone et al. reported that when DCS was performed on the patients with major bleeding diathesis, 82% of patients with coagulopathy were corrected. While in our study 75% of the patients with coagulopathy were corrected.

Frischkencht et al. reported that coagulopathy upon hospital admission was one of the strongest predictors of poor outcome among the lethal triad. In their study, early deaths presented with significantly deranged coagulation parameters including an elevate INR and lower platelet counts on hospital and ICU admission, In this study, 10 among 13 patients (76.9%) with coagulopathy and among them 10% of the patients with coagulopathy died. However, there was no case of mortality in the patients without coagulopathy. While in our study also coagulopathy and injury to ER time as well as injury to OR time was found to be significant with p value 0.0021, 0.007 and 0.0174. INR was noted initially in the ER. In the present study 9 out of the 12 patients who died had coagulopathy (75%) (111).

Steinemann et al. reported that hypothermic patients had a lower predicted probability of survival and a high mortality rate than euthermic patients. However, when patients were stratified by physiologic and anatomic indicators of injury severity, mortality rates among the euthermic and hypothermic patients were not significantly different. Early post-traumatic hypothermia does not appear to exert an independent effect upon outcome. In this study the mortality among the hypothermic patients was found to be 60.60%, higher than the mortality in euthermic patients. Compared to the present study 83.3% who died had hypothermia. This showed that the hypothermic state may reflect disease severity (112).

A review by Rotondo et al. identified 961 damage control patients in the literature, with 50%. While in our study, 48% mortality was there and our study concluded only 25 traumatic patients as our center was not a high volume center (113).

According to a study carried out by M. Sugrue et al. at Trauma Department, Liverpool Hospital, Elizabeth Street, Liverpool, NSW 2170, Australia, concluded that damage control generally and in particular applied to the abdomen is a fundamental and vital part of the management of a seriously injured patient. It should ideally be performed before the patient gets completely

exhausted. It should be used where the patient has severe injury, with impending hypothermia, acidosis and massive transfusion requirement. Surgery in the abdomen in this high-risk subgroup should be quick, thoughtful and in general be no longer than 1 hour. It is time for even technically adapt surgeons to realize that sometimes less is more (113).

While comparing to the present study in which the mean operative time was 2 and half hours which was way more than the prescribed less than 1 hour which was prescribed in above mentioned study but it did not affect the results.

According to the study conducted by Johnson et al. concluded that continued application of DC principles has led to improved survival with PAI. Better control of temperature, experience with the open abdomen, and intensive care unit care may be causative.Whereas in the present study blunt trauma abdomen patients (96%) formed the major part of the study and even they showed improved survival (44).

In another study conducted at Denver Health Medical Centre, University of Colorado Denver by Sorrentino et al. which was done to see the impact of damage control surgery on abdominal vascular trauma concluded that out of 64 patients included in the study who sustained a primary abdominal vascular injury, Fifty-eight (91%) were men with a mean age of 32.3 ± 14.5 (range, 15 to 80). Whereas in the present study out of the 25 patients included in the study, twenty-one patients (88%) were men with mean age of was 29.44 ± 11.43(range, 17-60). Mean injury severity score (ISS) was 27.3 ± 13.0 (range, 9 to 60). ISS was available for 62/64 patients. Compared to our study which had ISS available only for 21 patients out of 25 was 27.1 ± 8.23 (Range 13 to 48). In that study, majority (75%) sustained penetrating trauma and underwent DCS (53%). While comparing to the present study majority (96%) was blunt trauma who underwent DCS.ISS for survivors was 24.4 ± 12.5 versus 33.2 ± 12.4 for non-survivors ($p < 0.05$). In the present study it was 26.83 ± 7.06for the survivors and 27.46 ± 6.81for the non-survivors ($p = 0.531$).Mean systolic blood pressure (SBP) in the ED was 86.4 ± 49.0 (114).

While in present study 21 out25 patients the BP was recordable rest 4 had non-recordable BP. Mean blood pressure (SBP) in our study was 74 ± 36.11. Fourteen patients (22%) presented to the ED with a SBP less than 60 mm Hg; 12 patients had no palpable blood pressure on arrival. While in the present study, 2 patients presented to ED with a SBP less than 60mmHg; 4 patients had no palpable blood pressure on arrival.

Thirty-six patients (56%) had a SBP greater than 90 mm Hg (120.5 ± 20.8). The overall mortality for patients with SBP less than 90 mm Hg was 57% (16 patients) versus 8% mortality in patients with a SBP of at least 90 mm Hg. A SBP less than 60 mm Hg was associated with a high mortality of 86%. While in the present study 16 (48.48%) 10 patients had a SBP greater than 90mmHg (104.37 ± 8.63). The overall mortality for the patients with SBP less than 90mmHg was 27mmHg 75% (9 patients). The mean pH for all patients was 7.11 (N = 56). While it was 7.31 ± 0.06 in present study. Overall the transfusion ratio of FFP: PRBC in these patients was 1:2.6 vs. 2:3 as compared to the present study. But neither the PRBC ($p = 0.823$) nor the FFP ($p = 0.237$) had significance as far as the mortality is concerned. Patients who initially presented to the ED had INR value of 2.97 ± 1.14; with mortality, (66.7%), whereas the mean INR recorded was 1.61 ± 0.37which was found to be significant in the present study($p = 0.0021$) (114).

Mortality attributable to refractory coagulopathy was 19% while in our study it was 80%. The mean ISS was 26.83 ± 8.01 (N = 6), 21 ± 7.07 in survivors (N = 2), and 29.75 ± 7.5 in non-survivors (N = 4) while in the present study in survivors group was 26.83± 7.06 (N = 18) and non-survivor group is 27.46 ± 8.23 (N = 15). Mortality was 67% in patients with overt coagulopathy. In the present study it is 83.3%
High mortality associated with exsanguination was similarly reported by Asensio et al. in 2003. Adoption of damage control is associated with reduced mortality from abdominal vascular injuries due to coagulopathy, patients continuing to die from exsanguination represent a persistent challenge. Additional studies are warranted to differentiate between patients that have "acute coagulopathy due to trauma" and patients that are dying from consumptive coagulopathy due to surgical bleeding. Death from exsanguination eclipses coagulopathy as a primary cause of death in these patients, and remains a major problem (114).

Conclusion

Damage control surgery is a useful way of preventing the morality amongst the isolated abdominal trauma patients and its application has given better results in the non-traumatic patients.Young adults between the age group 21-30 years are most commonly affected.In traumatic cases, solid organ injury is the most common injury, of which liver is the most common organ involved. Often associated with some other major or minor injury. Delay in reaching the EMR was found to be associated maximum mortality in traumatic cases in our study. Exploratory laparotomy with liver packing was the most common procedure performed in the traumatic cases that underwent DCS. Patients meeting the "lethal triad" i.e. hypothermia, acidosis and coagulopathy have higher mortality (50%). Even individually hypothermia, acidosis and coagulopathy individually played important role in predicting the mortality. INR, Injury to ER and Injury to OR time were the most significant indicators for predicting mortality among such patients. Packing of the abdominal cavity or any quadrant provides high chances of survival and gives time for resuscitation phase.We concluded that AKI is the most common systemic complication in the patients with with trauma and surgical site infection was the most common local complication. AKI (75%) and Septic shock (25%) were the causes related to mortality in traumatic patients who underwent DCS. The

survival rate was 52% in trauma-tic cases who underwent DCS whereas there was 100% survival in non-traumatic cases that underwent DCS.

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