

Staged Abdominal Repair Surgery in Abdominal Compartment Syndrome- An Observational Study

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Abstract:

Objective: Staged Abdominal Repair Surgery in Abdominal Compartment Surgery. **Research design and methods:** The study was conducted on 45 patients who underwent laparotomy due to acute abdominal conditions and abdomen was closed in staged manner using staged abdominal repair surgery also known as STAR operation. Statistical analysis was performed and results analysed. **Results:** The present series comprising of 45 cases had low rate of grave complications like entero-cutaneous fistulae formation (< 16%), intra-abdominal infection (approx 17%), development of bedsore (approx 13%), chest infection (approx 22%). Average hospital stay was of 3 weeks and postoperative mortality of approximately 11%. **Conclusions:** We thus conclude that the STAR technique has definite edge over previous techniques of temporary abdominal closure and shows a new path of abdominal closure to the surgical fraternity .

The effects of increased abdominal pressure on various organ systems has been noted over the past century. Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) have been identified as a cause of organ dysfunction and mortality in several subsets of critically ill patients. The staged abdominal repair operation popularly known as STAR operation is a technique of temporary closure of abdomen during primary surgery followed by a second surgery 24 to 48 hours later ending in final aponeurosis closure of abdomen.. In abdominal compartment syndrome; this operation, is gaining popularity because it is life saving in critically ill patients and has lower complication rate as well.

Intra-abdominal pressure (IAP) is the steady pressure within the abdominal cavity. For critically ill patients, an IAP of 5 to 7 mm of Hg is considered normal. Intra-abdominal pressure (IAP) is graded as follows :

Grade I – IAP	2 to 15 mm of Hg
Grade II – IAP	16 to 20 mm of Hg
Grade III – IAP	21 to 25 mm of Hg
Grade IV – IAP	□□25 mm of Hg

Abdominal perfusion pressure (APP) is calculated as the mean arterial pressure (MAP) minus the IAP i.e $APP = MAP - IAP$. Multiple regression analysis have found that APP is better than other resuscitation endpoints such as arterial pH, base deficits, arterial lactate, and hourly urinary output for predicting outcomes. A target APP of at least 60 mmHg is correlated with improved survival from IAH and ACS.

Intra-abdominal hypertension (IAH) is defined as a sustained intra-abdominal pressure >12 mm of Hg. IAH impairs the function of nearly every organ-system. IAH decreases cardiac output by impairing cardiac function and reducing venous return. It causes cephalad movement of the diaphragm which leads to reduced ventricular compliance and reduced contractility. IAH obstructs blood flow in the inferior vena cava leading to diminished venous flow from the lower extremities resulting in formation of peripheral edema and increase risk of deep vein thrombosis. It causes alveolar barotrauma in mechanically ventilated patients. It reduces chest wall compliance which further lead to arterial hypoxemia, hypercarbia and pulmonary infections. It leads to impairment of renal function by causing renal artery vasoconstriction and renal vein compression. Gut is very sensitive to rise in intra abdominal pressure. . IAH compresses thin-walled mesenteric veins which impairs venous flow from the intestine and causes intestinal edema. The intestinal swelling further increases intra-abdominal pressure, initiating a vicious cycle. The end result is worsened hypoperfusion, bowel ischemia, decreased intramucosal pH, and lactic acidosis.

Abdominal compartment syndrome defined as a sustained intra-abdominal pressure > 20 mm Hg with or without abdominal perfusion pressure [APP] of < 60 mm Hg that is associated with new organ dysfunction. For clinical purposes, ACS is better defined as IAH-induced new organ dysfunction, without strict intra-abdominal pressure threshold.. Patients with intra-abdominal pressure below 10 mm Hg generally do not have ACS. ACS can be primary due to injury or disease in abdomino pelvic organs, secondary due to conditions not originating from abdomen or pelvis such as fluid resuscitation , sepsis or burns. Recurrent ACS refers to conditions in which ACS develops following previous medical or surgical conditions. ACS generally occurs in

patients who are critically ill due to various medical and surgical conditions such as trauma, burns, liver transplantation, sepsis, ascitis, bowel distension abdominal surgery etc.

I. Methods:

A study was conducted in 45 patients who underwent laparotomy due to acute abdominal conditions and abdomen was closed in staged manner using staged abdominal repair surgery. The study was performed in accordance with the ethical principles and was approved by the institutional ethics review board. Each participant provided a written informed consent.

The inclusion criteria included patients who had:

- Pre-operative IAP of 20 mm of Hg or above measured by U-tube method.
- Excessive intraperitoneal edema preventing abdominal closure without undue tension.
- Gut above the level of wound when looked horizontally before closure

Patients less than 10yrs of age with acute abdominal conditions were excluded from the study

Intra-abdominal pressure (IAP) was measured bed side by using U-tube technique. Patient was positioned supine with the head on the bed flat with a urinary catheter in place. When the patient is quiet and calm and abdominal contractions absent urinary catheter was raised above the patient, allowing an U shaped loop to develop. Connection site (the zero level) where the catheter meets the drainage tubing in line with symphysis pubis was leveled. Fluid column was allowed to settle and using the centimeter ruler, measurement was done from 'zero' connection site to meniscus of the fluid column

Staged abdominal repair surgery was planned either preoperatively or during the operation if pathology so demanded. After dealing with pathology of abdomen and giving two mallecot drains one in right flank and one in pelvis, abdomen was left open with cotton drape sutured to skin margin to prevent evisceration of intestine. Patients were shifted to ward with dressings over it. After 24 hours patients were again brought to OT, drape removed, and corrugated rubber drain was stitched to skin margin under ketamine anaesthesia. Rectus sheath was left untouched. Patients were again shifted to ward. On the 8th day, under ketamine anaesthesia, the corrugated rubber that was removed and aponeurosis to aponeurosis closure was done.

Post operatively vitals were monitored. Hb%, total and different count of WBC, kidney function test, serum electrolytes such as Na⁺, K⁺, Ca⁺ and bicarbonate were repeated on alternate days. Dressing of wound was done daily. IAP was measured 6 hourly for the first 3 days and then 12-hourly.

II. Results And Analysis:

The study was conducted on 45 cases of acute abdomen who underwent staged abdominal repair surgery. The age distribution was as follows:

Age Group in years	No. of Cases	Percentage
0-10	0	0%
11-20	5	11.11%
21-30	10	22.22%
31-40	10	22.22%
41-50	12	26.66%
>50 years	08	17.77%

TABLE 1 : Age distribution of patients

Out of 45 patients studied in present series maximum incidence of patients undergoing STAR operation was between 41-50 years (26.66%); followed by age group 21-30 years (22.22%). 40.43% of patients undergoing STAR operation were more than 40 years of age.

Out of 45 patients, 15 (33.34%) had duodenal perforation, 10 (22.22%) had gastric perforation; 08 (17.17%) had ileal perforation; 05 (11.11%) had intestinal obstruction due to band and adhesions; 03 (6.66%) had appendicular perforation; 03 (6.66%) had intestinal obstruction due to volvulus; and 1 (2.22%) had traumatic jejunal perforation.

Pathology	No. of Cases (Total no-45)	Percentage
Duodenal perforation	15	33.34%
Gastric perforation	10	22.22%
Ileal perforation	08	17.17%
Appendicular perforation	03	6.66%
Intestinal obstruction due to band and adhesions	05	11.11%
Intestinal obstruction due to volvulus	03	6.66%
Traumatic jejunal perforation	01	2.22%

TABLE 2 : Different pathology of acute abdominal conditions for which STAR operation was performed.

At the time of admission out of 45 patients 25 (55.55%) had IAP in the range of 21-30 mm of Hg; 10 (22.23%) had IAP more than 30 mm Hg; 8(8.88%) had the IAP in range 11-20 mm of Hg; 2 (4.44%) had IAP less than 10 mm of Hg.

IAP was more than 20 mm of Hg in 35 patients (77.78%) and was due to intra-abdominal peritonitis, intra-peritoneal swelling of viscera and continuous fluid administration and distension of abdomen. After 24 hours of STAR operation 30 (66.66%) had IAP of less than 10 mm of Hg, 13 (28.88%) had IAP in the range of 11-20 mm of Hg, 2 (4.45%) had IAP in the range of 21-30 mm of Hg and none of the patient had IAP of more than 30 mm of Hg. IAP was less than 20 mm of Hg in 43 patients (95.55%) at 24 hours of STAR operation was due to the decompression of abdomen by laparotomy and staged abdominal closure of abdomen . After 48 hours; 36 (80%) had IAP in the range of 0-10 mm of Hg; 8 (17.77%) had IAP in the range of 11-20 mm of Hg; 1 (2.23%) had IAP in the range of 21-30 mm of Hg. None of the patient had IAP of more than 30 mm of Hg.IAP was less than 20 mm of Hg in 44 patients at 48 hours of STAR operation. It was due to the serial closure of abdomen exerting no tension at the wound edge.

at the 6th post-operative day, 40 (88.88%) had IAP in the range of 0-10 mm of Hg, 5 (11.12%) had IAP in the range of 11-20 mm of Hg. None of the patients had IAP of more than 20 mm of Hg.

Thus, out of 45 patients, who underwent STAR operation, all patients (100%) had IAP below 20 mm of Hg at 6th POD, and they were not having abdominal compartment syndrome (ACS) according to the definition of ACS.

Intra-abdominal pressure (IAP) measured by U-tube method	Number of cases (Total no=45)			
	Preoperative period	1 st postoperative day	2 nd postoperative day	6 th postoperative day
0-10 mm of Hg	2	30	36	40
11-20 mm of Hg	8	13	08	05
21-30 mm of Hg	25	02	01	00
>30 mm of Hg	10	00	00	00

TABLE 3 : Intra-abdominal pressure (IAP) measured by U-tube method in preoperative & postoperative period.

The incidence of post operative complications was low. Complications included entero-cutaneous fistula formation, intra-abdominal infection, bed sores and chest infection. Out of 45 patients, 36 patients (80.00%) had hospital stay between 11-20 days. In 9 patients (20%), total hospital stay was more than 20 days.

Complications	No. of Cases	Percentage
Entero-cutaneous fistula formation	07	15.55%
Intraabdominal infections	08	17.17%
Bedsore	06	13.33%
Chest infections	10	22.22%
Mortality	05	11.11%

TABLE 4 : Incidence of postoperative complications

III. Discussion:

Abdominal compartment syndrome is defined as the sudden increase in intra-abdominal pressure resulting in the alteration in respiratory mechanism, hemodynamic parameters, renal as well as cerebral perfusion. Any insult that results in acute increase in the volume of abdominal components sufficient to cause pressure related end organ dysfunction can lead to abdominal compartment syndrome. These can include abdominal trauma, ruptured abdominal artery aneurysm, retro peritoneal haemorrhage, pancreatitis, burns and sepsis. Open abdomen has become a significantly more common intermediate step in treatment of abdominal emergencies. The main goal after the open abdomen procedure is to stabilize the patient's condition and achieve abdominal closure as soon as possible. There are many methods of temporary closure of abdomen. These include the Wittman patch, the abdominal reapproximation anchor system, staged abdominal repair, negative pressure wound therapy and mesh mediated traction technique.

Staged abdominal repair surgery (STAR) operation is a technique of serial operation, planned either before or during the first index operation. During the course of treatment a controlled tension is exerted on the margins avoiding an artificially caused "abdominal compartment syndrome" due to intra-abdominal inflammation, oedema and paralytic ileus.

STAR operation is gaining popularity because it has low complication rate and is easy to perform. Virtually all materials which are non-reactive to body tissues, can be used for temporary closure of abdomen such as corrugated rubber drain sheet and cotton towels .

Being a new technique, the STAR operation requires further evaluation. The available surgical literature speaks little.

According to Wittmann and colleagues, STAR operation appears to reduce mortality by 50% over the standard operations.

STAR operation, facilitate easy second look after stabilization of the patient's general condition, decompresses the abdomen and helps in organ recompensation.

IV. Summary And Conclusion

The present study, popularly known as "STAR operation in abdominal compartment syndrome" is becoming day by day popular because of time and life saving characteristics with lower complication rate in critically ill patients suffering from acute abdomen. The present series comprising 45 cases had very low rate of grave complications like entero-cutaneous fistulae formation (< 16%), intra-abdominal infection (approx. 17%), development of bedsore (approx. 13%), chest infection (approx. 22%). An average hospital stay of 3 weeks and postoperative mortality of only 11% (approx).

In the present series, probably it shows a new path of abdominal closure to the surgical fraternity and requires more and more studies at highly developed surgical centres to establish the procedure. So, we conclude that the STAR technique has definite edge over previous techniques involving zipper application, retention sutures and various other techniques of temporary abdominal closure like VAC, vaccum pack, artificial burr (Wittmann Patch), bagota bag, mesh application and loose packing.

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