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Association of Intra-Abdominal Pressure with Wound Dehiscence in Patients Undergoing Emergency Exploratory Laparotomy by Midline Incision

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ABSTRACT

Aim: To study the association between raised intra-abdominal pressure and abdominal wound dehiscence in patients undergoing emergency exploratory laparotomy by midline incision.
Method: Fifty patients were taken up for emergency midline exploratory laparotomy and followed up for wound dehiscence and their association with raised intra abdominal pressure.
Results: The variables significantly associated with dehiscence were raised IAP, obesity and overweight. Anemia as factor for dehiscence was non significant.
Conclusion: Raised intra-abdominal pressure has a significant effect on overall patient outcome leading to wound dehiscence and obesity and overweight status contribute to this by raising the intra abdominal pressure.

Keywords: Intra Abdominal Pressure, Wound Dehiscence, Exploratory Laparotomy, Midline

INTRODUCTION

The abdomen is defined as the area bound by the diaphragm superiorly and marked inferiorly by the pelvic brim, extending into the pelvic cavity, anteriorly the anterior abdominal wall and posteriorly the spine and attached musculature. The closed nature of the abdomen and the elastic recoil of the walls give rise to the phenomenon of intra abdominal pressure (IAP), the pressure within the abdominal cavity. In 2004, the World Society on Abdominal Compartment Syndrome (WSACS) was formed which lead to the creation of standard consensus definitions for IAP and its elevated pathological states – intra abdominal hypertension (IAH) and abdominal compartment syndrome (ACS)

The consensus definitions are as follows:

1. Intra-abdominal pressure (IAP) is the pressure concealed within the abdominal cavity.
2. Normal IAP is approximately 5-7 mmHg in critically ill adults.
3. IAH is defined by a sustained or repeated pathologic elevation of IAP >= 12 mmHg
4. IAH is graded as follows: Grade I: IAP 12-15 mmHg, Grade II: IAP 16-20 mmHg, Grade III: IAP 21-25 mmHg, Grade IV: IAP > 25 mmHg
5. Abdominal compartment syndrome (ACS) is defined as a sustained IAP > 20 mmHg (with or without an APP < 60

mmHg) that is associated with new organ dysfunction/failure.
6. Primary ACS is a condition associated with injury or disease in the abdomino-pelvic region that frequently requires early surgical or interventional radiological intervention
7. Secondary ACS refers to conditions that do not originate from the abdomino-pelvic region
8. Recurrent ACS refers to the condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary ACS

IAP is the result of the dynamic interaction between the abdominal wall and the viscera. The IAP oscillates according to the respiratory phase and abdominal wall resistance.

There are various factors that can cause elevation of IAP and lead to IAH and ACS. These can be broadly divided into three groups – diminished wall compliance, increased abdominal contents and capillary leak and fluid resuscitation. [1]

Adverse effects of IAH and ACS

The negative effect of raised IAP and IAH and ACS on organ perfusion and ventilation is the main cause of concern. Adverse effects of IAH and ACS are widespread and involve almost all body systems to varying degrees depending on the level of IAH and ACS and the system involved. [1]

For the cerebral system, it leads to raised jugular venous pressure, decreased venous return, increased intra cerebral pressure and decreased cerebral blood flow.

In the cardio vascular system, IAH leads to decreased venous return, increased central venous pressure, increased pulmonary artery wedge pressure and overall increase in myocardial stress.

The respiratory system is affected in such a way that it leads to decreased intrathoracic space and restricted respiration. This leads to decreased lung compliance and functional residual capacity, V/Q mismatch and hypoxia.

The renal and gastrointestinal systems are located in the abdominal cavity and bear the brunt of IAH and ACS. There is decreased renal blood flow leading to oliguria and anuria along with RAAS activation which further adds to IAP. The digestive system suffers from decreased tissue perfusion and ischemia.

Measurement of IAP

There are various methods to measure IAP – intra gastric, intra rectal, inferior vena cava and urinary bladder pressure monitoring.[2] Out of all these, WSACS advocates indwelling urinary catheter pressure monitoring as the Gold standard (modified Kron's technique).

WSACS recommends intermittent IAP measurement. The value is measured twice over a 6 hour period. In case IAP > 12 mmHg, fourth hourly measurement is recommended. When IAP is measured in cmH2O, it is converted to mmHg using the formula 1mmHg = 1.36 cm H2O

Exploratory laparotomy is one of the most common surgical procedures performed in emergency department. One of the most common complications following exploratory laparotomy is abdominal wound dehiscence. The causes for wound dehiscence are surgery on contaminated and clean contaminated field, post-operative infection, raised IAP, obesity, etc.[3] IAP may be an important determinant of abdominal wound dehiscence and organ dysfunction.[4] Abdominal wound dehiscence is the first complication to become visible in abdominal surgeries overtly. Wound dehiscence causes increased chances of infection introduction from outside into abdominal wall and cavity. The patient is less ambulatory which leads to lower lung and cardiac functioning and increased risk of cardiopulmonary complications like pneumonia. When wound dehiscence progresses to burst abdomen the complications are increased manifold and are associated with greater morbidity and mortality.

Elevation in intra-abdominal pressure can occur in post-operative period. This can be due to incomplete resolution of underlying pathology during surgery, fluid leak into abdominal cavity like blood and/or bowel contents, iatrogenic injury to hollow or solid viscera during surgery, bowel edema, ascites, obesity etc. This elevation in IAP causes the tension in the abdominal wall to rise which has negative impact on blood supply to the abdominal wall and intra-abdominal organs.

In this study, we observed the effect of raised IAP in post operated patients with midline laparotomy wound and its effect on various intra abdominal organs.

MATERIALS & METHODS

Fifty patients who underwent exploratory laparotomy by midline incision in emergency sitting were included prospectively in the study. The exclusion criteria were incisions other than midline and laparotomy converted to laparostomy. The participating patients were explained about the procedure, the possible complications and informed consent was taken for the procedure and participation in the study. They were given the option to withdraw from the study at any stage without affecting the treatment. All patients underwent standard preoperative workup and intra abdominal pressure measurement (by modified Kron's technique)

The participants underwent midline incision exploratory laparotomy and IAP was measured for 5 days post operatively. If there was no feature of wound dehiscence, end point was clean, dry wound with healthy suture line after 5 days of surgery. If wound was healthy and no sign of dehiscence, patient was discharged on 6^{th} day post operatively and called for suture removal on 10^{th} day.

Identification of wound dehiscence – cases where midline wound dehiscence had occurred were identified by presence of features of surgical site infection or any sero-sanguinous or pus discharge from the wound. Southampton wound scoring system was used –

Grade

0. Normal healing
1. Normal healing with mild bruising or erythema
2. Erythema plus other signs of inflammation
3. Clear or hemoserous discharge
4. Pus or purulent discharge
5. Deep or severe wound infection with or without tissue breakdown

RESULT

The study was conducted in the Surgical Emergency of ABVIMS and Dr. Ram Manohar Lohia Hospital. The total participants were 50 patients who presented to the surgical emergency and subsequently underwent emergency exploratory laparotomy.

Table 1: Incidence of Dehiscence

Dehiscence	Patients	Total
NO	29	29
YES	21	50

Out of the study patients, almost three – fifths (58%; 29) had healthy midline at the end of study period while 42% patients (21) had variable degree of wound dehiscence.

Table 2: Day of Dehiscence

Day of Dehiscence	Patients	Total
2	3	3
3	8	11
4	5	16
5	5	20

Out of the total dehiscence patients (21), the most dehiscence occurred on the third day (8) followed by day 4 (5), day 5 (5) and day 2 (3).

Table 3: Southampton Score

Southampton score	Patients	Total
0 (normal healing)	29	29
1 (normal healing with mild erythema)	0	29
2 (erythema plus other signs of inflammation	4	33
3 (clear or hemoserous discharge)	5	38
4 (pus or purulent discharge)	5	43
5 (deep or severe wound infection with or without tissue breakdown)	7	50

Almost three – fifths of the patients (58%) had a Southampton score of zero, indicating healthy midline wound. The next most frequent score was 5 with seven patients having this level of dehiscence indicating tissue breakdown. This was followed by the scores 3 and 4 with both having five patients each. Four patients had a score of 2.

Table 4: IAP post op day 1 and wound dehiscence

Wound Dehiscence		No	Yes	Significance *
IAP	Normal	14	00	p = 0.000
	Raised	16	20	

***Fisher's exact test**

On post op day 1, all patients who developed AWD (100%) had raised IAP, whereas among those who did not develop AWD this percentage was 53.3%. This was significant (p = 0.000)

Table 5: IAP post op day 3 and wound dehiscence

Wound Dehiscence		No	Yes	Significance *
IAP	Normal	12	1	P = 0.007
	Raised	17	19	

***Fisher's exact test**

At post op day 3, 19 patients (95%) with wound dehiscence had elevated IAP and only 1 patient with wound dehiscence had normal IAP. For those with no wound dehiscence, 17 had raised IAP (58.6%). This was significant (p = 0.007)

Table 6: IAP post op day 5 and wound dehiscence

Wound Dehiscence		No	Yes	Significance *
IAP	Normal	25	9	P = 0.003
	Raised	3	10	

***Fisher's exact test**

At post op day 5, 10 patients (52.9%) with wound dehiscence had raised IAP and 9 patients with wound dehiscence having normal IAP. Among those who did not have wound dehiscence, 89.3% had normal IAP. This was significant. (p = 0.003)

Table 7: Hemoglobin level and wound dehiscence

Wound Dehiscence		No	Yes	Significance *
Hemoglobin	Less than 10gm/dl	8	10	P = 0.145
	10 or more gm/dl	21	11	

***Chi-Square test**

Hemoglobin at presentation was less than 10gm/dl for 47% of patients who developed wound dehiscence while for those who did not develop wound dehiscence, 38% had haemoglobin level less than 10 gm/dl. This was non-significant. (p = 0.145)

Table 8: BMI and Wound Dehiscence

Wound Dehiscence		No	Yes	Significance *
BMI	Less than 25 kg/m2	21	5	p = 0.000
	More than 25 kg/m2	8	16	

***Chi-Square test**

16 patients with wound dehiscence (76.1%) had BMI more than normal while 8 patients with BMI more than normal had no wound dehiscence. This was statistically significant. (p = 0.000)

DISCUSSION

Emergency exploratory laparotomy is a very commonly performed procedure for a variety of abdominal emergencies. The abdominal pathologies and the surgical intervention, both can lead to raised intra abdominal pressure, which can have a deleterious effect on the patient ranging from wound dehiscence to organ dysfunction to eventual mortality. This study was undertaken to analyze this effect.

DEHISCENCE

Out of the study patients, almost three – fifths (58%; 29) had healthy midline at the end of study period while 42% patients (21) had variable degree of wound dehiscence. In the study of Gupta Naveen et al, [5] the wound dehiscence rate was 30%. This shows that wound dehiscence occurs in substantial number of patients operated during emergency. The study of Wibisono et al [6] identified emergency surgery as a risk factor for wound dehiscence.

DAY OF DEHISCENCE

Out of the total dehiscence patients (21), the most dehiscence occurred on the third day (8) followed by day 4 (5), day 5 (5) and day 2 (3). In the study of van Ramshorst at al [7] and Jaiswal NK at el,[8] the most common time for dehiscence was post op day 5 and 7 respectively. This can be explained with the definition for wound dehiscence. In our study, wound dehiscence is considered starting with erythema around the sutures while in other studies, opening up of suture line with tissue loss is considered as wound dehiscence.

HEMOGLOBIN AND WOUND DEHISCENCE

Hemoglobin at presentation was less than 10gm/dl for 47% of patients who developed wound dehiscence while for those who did not develop wound dehiscence, 38% had haemoglobin level less than 10 gm/dl. This was non-significant. ($p = 0.145$)

IAP AND WOUND DEHISCENCE

On post op day 1, all patients who developed AWD (100%) had raised IAP, whereas among those who did not develop AWD this percentage was 53.3%. This was significant ($p = 0.000$)

At post op day 3, 19 patients (95%) with wound dehiscence had elevated IAP and only 1 patient with wound dehiscence had normal IAP. For those with no wound dehiscence, 17 had raised IAP (58.6%). This was significant ($p = 0.007$)

At post op day 5, 10 patients (52.9%) with wound dehiscence had raised IAP and 9 patients with wound dehiscence having normal IAP. Among those who did not have wound dehiscence, 89.3% had normal IAP. This was significant. ($p = 0.003$)

This is in accordance to study of Gupta N et al [5] and Talukdar M et al [9] which found a strong linear correlation between raised IAP and abdominal wound dehiscence and raised IAP to be a significant risk factor for AWD. The study of Wibisono JJ et al [6] also had raised IAP as a risk factor for wound dehiscence.

BMI AND DEHISCENCE

16 patients with wound dehiscence (76.1%) had BMI more than normal while 8 patients with BMI more than normal had no wound dehiscence. This was statistically significant ($p = 0.000$). This is in accordance with the study of Pavlidis et al[10] which had obesity as a significant risk factor for abdominal wound dehiscence. The study of Kapoor KK et al[11] also found BMI > 25 kg/m2 as a significant risk factor for dehiscence.

CONCLUSION

The aim of the study was to study the association between raised intra-abdominal pressure and abdominal wound dehiscence in patients undergoing emergency exploratory laparotomy by midline incision

On the basis of our study, we observed:

1. There is a statistically significant association between raised intra-abdominal pressure and abdominal wound dehiscence in patients undergoing emergency exploratory laparotomy.
2. Anemia is not found to have significant association with abdominal wound dehiscence.
3. Overweight and obesity (BMI > 25 kg/m2) is a significant risk factor for abdominal wound dehiscence

Therefore, from this study we would like to conclude that raised intra abdominal pressure has a significant effect on overall patient outcome. It affects not only wound

healing but also has a considerable mortality risk. Overweight and obesity affects patients by leading to rise in IAP. This information can be used to plan specific patient oriented treatment protocol to help prevent and mange IAH and ACS in the emergency setting and achieve favorable patient outcome.

Declaration by Authors

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