

Clinical Profile of Patients with Postoperative Adhesive Intestinal Obstruction and its Association with Intraoperative Peritoneal Adhesion Index

Varun Sisodia, Shantanu Kumar Sahu, Saurabh Kumar

Department of General Surgery, Himalayan Institute of Medical Sciences, Swami Rama Himalayan University, Dehradun, Uttarakhand, India

Rezumat

Profilul clinic al pacienților cu obstrucție intestinală postoperatorie secundară aderențelor și asocierea acestuia cu indexul intraoperator de aderențe peritoneale

Aderențele postoperatorii reprezintă o problemă majoră căreia încă nu i s-a găsit soluție. Acestea apar în 50% până la 100% din toate intervențiile chirurgicale la nivel abdominal și pot complica munca medicului chirurg considerabil. Aderențele peritoneale sunt bride patologice care se formează de obicei între oment, intestinul subțire și intestinul gros. Aceste bride pot fi reprezentate de un film subțire de țesut conjunctiv, o punte fibroasă groasă conținând vase de sânge și țesut nervos sau o aderență directă între suprafețele a două organe.

Scopuri și obiective: 1. De a studia profilul clinic al pacienților supuși laparotomiei pentru obstrucție intestinală secundară aderențelor. 2. De a evalua și analiza indicele PAI al aderențelor peritoneale intraoperatorii în cazuri individuale. 3. De a asocia profilul clinic cu indicele de aderențe peritoneale la pacienții cu obstrucție intestinală secundară aderențelor.

Rezultate: Studiul de față a fost efectuat în cadrul Secției de Chirurgie a Institutului de Științe Medicale Himalaya, Universitatea SRH, Dehradun, India, pe parcursul a 12 luni. Un număr total de 30 de pacienți cu diagnostic de obstrucție intestinală secundară aderențelor postoperatorii au fost incluși în

studiu. S-a observat că aderențele din fiecare regiune abdominală contribuie în mod egal la indicele PAI total. În cadrul acestui studiu s-a observat că pacienții supuși anterior chirurgiei de urgență au prezentat un indice mai crescut al aderențelor decât cei supuși operațiilor programate, pe când pacienții supuși atât chirurgiei de urgență cât și celei de elecție în trecut au prezentat indicii de aderențe cei mai scăzuți. Analiza tipurilor diferite de cicatrice postoperatorii din cadrul grupurilor nu a prezentat semnificație statistică ($P > 0.05$), prin urmare pacienții prezintă șanse egale de a dezvolta aderențe indiferent de tipul de cicatrice abdominală postoperatorie.

Concluzii: Indicele PAI este un instrument sensibil în evaluarea clinică și intraoperatorie a obstrucției intestinale secundară aderențelor, în cuantificarea aderențelor și oferă o descriere precisă a condițiilor abdominale ce stau la baza afecțiunii în cursul planificării abordării terapeutice chirurgicale a acesteia.

Cuvinte cheie: indice al aderențelor peritoneale, obstrucție intestinală secundară aderențelor, laparotomie, cicatrice

Abstract

Adhesions following surgery represent a major unsolved problem. They occur after 50% to 100% of all surgical interventions in the abdomen and may complicate the work of the surgeon considerably. Peritoneal adhesions are pathological bands that typically form between the omentum, the small and large bowels, the abdominal wall, and other intra-abdominal organs. These bands may be a thin film of connective tissue, a thick fibrous bridge containing blood vessels and nerve tissue, or a direct adhesion between two organ surfaces.

Aims and Objectives: 1. To study the clinical profile of patients

Corresponding author:

Dr. Shantanu Kumar Sahu
Prof. & Head
Department of General Surgery
Himalayan Institute of Medical Sciences
Swami Rama Himalayan University
Dehradun, Uttarakhand, India, 248140
E-mail: Intshantanu@yahoo.co.in

with adhesive intestinal obstruction undergoing laparotomy. 2. To assess and analyze the intra-operative peritoneal adhesion index (PAI) in individual cases. 3. To associate the clinical profile with peritoneal adhesion index in patients of adhesive intestinal obstruction.

Result: The study was conducted in the Department of Surgery, Himalayan Institute of Medical Sciences (HIMS), SRH University, Dehradun, India over a period of 12 months. A total of 30 patients with diagnosis of post operative adhesive intestinal obstruction were recruited in the study. It was observed that adhesions over each abdominal region contributed equal to the total PAI. In this study it was observed that the patients who had previous emergency surgery had higher incidence of adhesions, than elective surgery whereas those patients who underwent both elective and emergency surgeries, the incidence of adhesions were lowest. Analysis of variance with respect to abdominal scar resulted that the difference between groups was observed to be statistically not significant ($P > 0.05$), so patients with all type of abdominal scars of previous surgeries has equal chance of developing adhesions.

Conclusion: PAI is a sensitive tool for clinical and intra-operative assessment of adhesive intestinal obstruction for the quantification of the adhesions and gives a precise description of the underlying intra-abdominal condition while planning a surgical management of the disease

Key words: peritoneal adhesion index, adhesive intestinal obstruction, laparotomy, scar

Introduction

Adhesions following surgery represent a major unsolved problem. (1) They occur after 50% to 100% of all surgical interventions in the abdomen and may complicate the work of the surgeon considerably. (2) Dembrowski published the first data on induction of adhesions in an animal model in 1889 and the intervening 120 years have seen extensive studies in vitro and in vivo. (3) Liakakos et al. reported that adhesions form in more than 90% of patients undergoing major abdominal surgeries and in 15-100% of women undergoing pelvic surgeries. Despite extensive efforts to reduce and prevent adhesions they form nevertheless and only meticulous surgical technique has been advocated to reduce unnecessary morbidity and mortality. (4)

All abdominal surgeries carry the risk of adhesion formation. Adhesions are more common following procedures involving intestines, colon, appendix, or uterus. They are less common following surgeries involving the stomach, gall bladder, or pancreas. Although most abdominal adhesions do not cause problems, they can be painful when stretched or pulled because the scar tissue is not elastic or may cause intestinal obstruction. Small bowel obstruction is one of the most common consequences of peritoneal adhesions. Peritoneal

adhesions are pathological bands that typically form between the omentum, the small and large bowels, the abdominal wall, and other intra-abdominal organs. These bands may be a thin film of connective tissue, a thick fibrous bridge containing blood vessels and nerve tissue, or a direct adhesion between two organ surfaces. (5)

Peritoneal adhesions represented an important clinical challenge in gastrointestinal surgery. A standardized classification system of adhesions to universalize their definition based on the macroscopic appearance of adhesions and their distribution in the different regions of the abdomen has been proposed called Peritoneal Adhesion Index (PAI). Using specific scoring criteria, clinicians can assign a peritoneal adhesion index (PAI) ranging from 0 to 30, thereby giving a precise description of the intra-abdominal condition. (6) With this background we intend to study the clinical profile of patients with post-operative adhesive intestinal obstruction presenting to this hospital and attempt to classify patients according to the Peritoneal Adhesion Index (PAI) during surgery. This study should enable us to understand the effectiveness of PAI in facilitating accurate description of intra-abdominal condition in terms of adhesion (for research purposes), in addition to a better understanding of the pathogenesis of adhesive obstruction.

Aims and Objectives

1. To study the clinical profile of patients with adhesive intestinal obstruction undergoing laparotomy.
2. To assess and analyze the intra-operative peritoneal adhesion index in individual cases.
3. To associate the clinical profile with peritoneal adhesion index in patients of adhesive intestinal obstruction.

Materials and Methods

The prospective observational and cross sectional study of sample size 30 patients was conducted in the Department of Surgery, Himalayan Institute of Medical Sciences (HIMS), SRH University, Dehradun, India, over a period of 12 months. All patients presenting in surgical OPD or emergency department with diagnosis (Clinical or imaging) of post operative adhesive intestinal obstruction who require surgical intervention were included in the study.

Exclusion criteria:

1. Those patients who were admitted with post operative adhesive intestinal obstruction but conservatively managed.
2. Those unfit for surgery.
3. Primary adhesive intestinal obstruction.

Study Tools:

1. Structured study instruments (Case Reporting Form/ Formats) were developed and used to generate data.
2. PAI (Peritoneal adhesion index). (6)

Study Protocol:

- I. Patients were evaluated by history and thorough clinical examination and followed by investigations
- II. Patients planned for surgery, intra-operative findings

were noted.

III. Intra-operative findings were compared with PAI (Peritoneal adhesion index).

IV. In clinical profile of patients following variables were studied:

- Nature of surgery
- Type of surgery
- Previous surgical scar mark
- Number of previous surgeries
- Duration since previous surgery

Statistical analysis was done using SPSS version 22 and was carried out using appropriate tests of significance viz. (Student 't' Test and ANOVA) and non-parametric (Chi square) tests to ascertain statistical significance. P-value calculated to be less than 0.05 was kept as criteria for statistical significance. Interpretation of results was made on the basis of statistical inferences.

Results

The study was conducted in the Department of Surgery, Himalayan Institute of Medical Sciences (HIMS), SRH University, Dehradun, India over a period of 12 months. A total of 30 patients with diagnosis of post operative adhesive intestinal obstruction were recruited in the study and out of 30 subjects 22 (73.33 %) patients were male and rest 8 (26.66) were female. Out of 30 subjects maximum number of patients i.e. 6 (20.00%) were in 21-30 years of age group and least number of patients i.e. 2 (6.67%) were below 21 years.

Out of 30 subjects, majority of patients i.e. 26 (86.67%) had history of one previous surgery. (Table 1)

Classification of subjects based on the types of scar marks under present study was described in Table 2. Out of 30 subjects, majority of patient's i.e. 19 (63.33%) had Midline scar mark followed by 3 (10.00%) patients with Grid iron scar mark.

Out of 30 subjects, 14 (46.67%) patients had emergency nature of previous surgery (EMR), 12 (40.00%) had elective nature of previous surgery and 4 (13.33%) had emergency as well as elective (EMR+Elective) nature of previous surgeries. (Table 3)

Classification of subjects based on the type of previous surgery under present study is described in Table 4. Out of 30 subjects, maximum number i.e. 11 (36.67%) patients had Gastro-intestinal type of previous surgery (GIS) followed by 6 (20.00%) patients who had history of gynecological surgery and similar number came with history of unspecified type of surgery

Classification of subjects based on duration since previous surgery under present study is described in Table 5. Out of 30, half (50.00%) of the patient's had 0-5 years duration since previous surgery followed by 4 (13.33%) patients who had surgery 06-10 years back and only 1 (3.33%) patient underwent surgery 11-15 years back.

In our study it can be concluded that adhesions in all the regions of abdomen contributed to our study. (Fig. 1)

Average spectrum of PAI ranging between 0 and 5 is presented in Table 6. Mean Adhesion grade score of 0.67 in

Peritoneal adhesion index

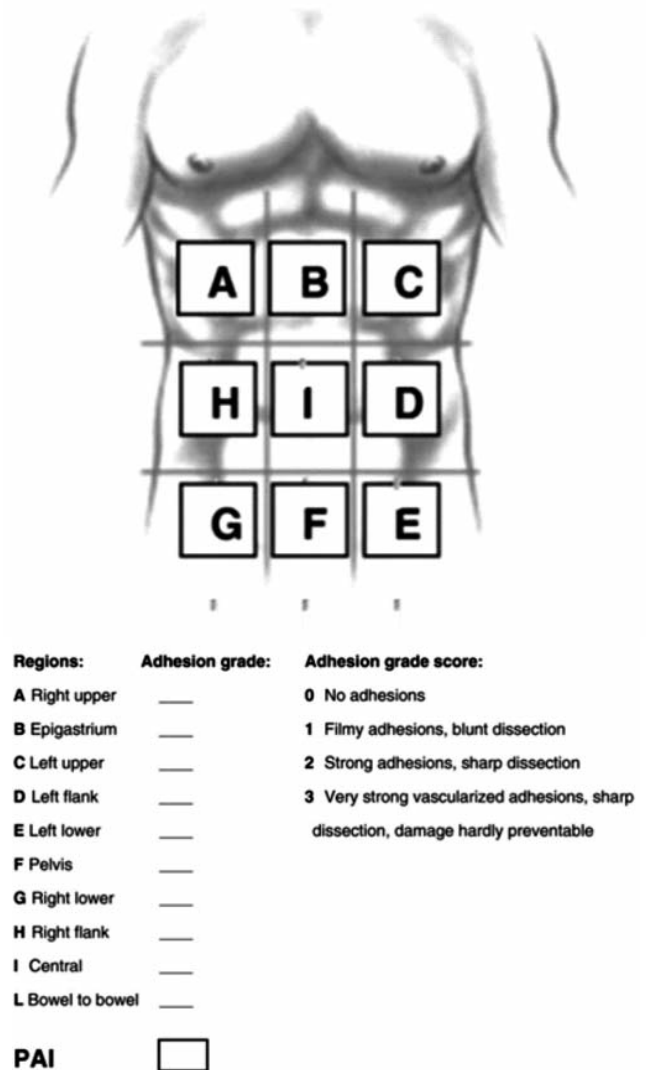


Table 1. Classification of Patients based on Number of Previous Surgery (n=30)

No. of previous surgery	No. of Patients	Percentage (%)
One	26	86.67
Two	4	13.33

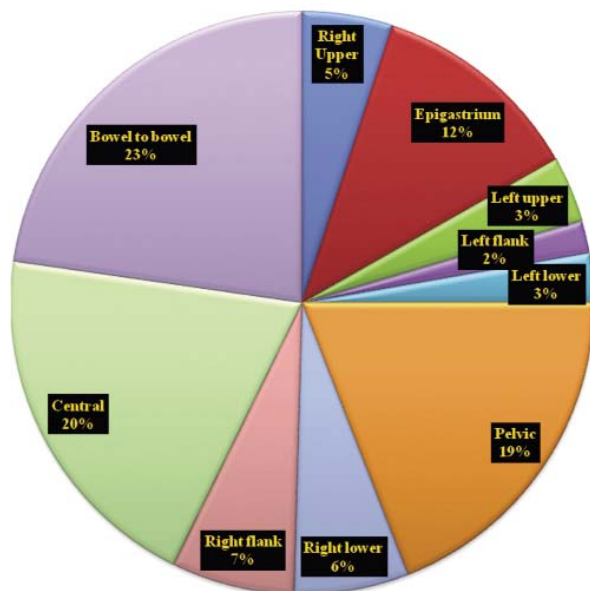
Table 2. Classification based on the Types of Scar Marks (n=30)

Type of scar mark	No. of surgery	Percentage (%)
Pfannenstiel incision	1	3.33
Grid iron	3	10.00
Grid Iron+ Pfannenstiel incision	1	3.33
Grid Iron+ Port scar mark	1	3.33
Grid Iron+ Pfannenstiel incision	1	3.33
Midline	19	63.33
Midline + Midline	1	3.33
Laparoscopic Port Scar	1	3.33
Right rooftop	2	6.67

Table 3. Classification of Subjects based on Nature of Previous Surgery (n=30)

Nature	No. of patients	Percentage (%)
EMR	14	46.67
Elective	12	40.00
EMR + Elective	4	13.33

EMR- Emergency nature of previous surgery

**Figure 1.**

average spectrum of PAI ranging between 0 and 5 was seen in Right Upper, Epigastrium, Pelvic and Bowel to Bowel region.

Left upper, Left flank, Left lower and Right lower region contributed to 0.00 ± 0.00 index ranging between 0.00 and 0.00

Analysis of variance resulted that the difference between groups was observed to be significant as the P Value (0.00) was lower than 0.05 and F value (16.80) was greater than F critical value (2.01) at 5% level of significance.

In present study, 6 patients were found having PAI between 0 and 5 in which more common adhesions were observed in Epigastrium region, Bowel to Bowel region and Pelvic region.

Average spectrum of PAI ranging between 6 and 10 is presented in Table 7. Maximum mean Adhesive grade score i.e. 1.90 ± 0.45 was seen in Bowel to Bowel region followed by Central region with mean grade score of 1.60 ± 0.88 . Minimum mean adhesive score i.e. 0.00 ± 0.00 was found in left flank region.

Analysis of variance resulted that the difference between groups was observed to be significant as the P Value (0.00) was lower than 0.05 and F value (180.85) was greater than F critical value (1.88) at 5% level of significance.

In our study, 21 patients were found having PAI between 06 and 10 in which more common adhesions were observed in Bowel to Bowel region.

Table 4. Classification of Subjects Based on Types of Previous Surgery (n=30)

Types of previous surgery	No. of surgery	Percentage (%)
GIS	11	36.67
GIS+GIS	1	3.33
GIS+GY	2	6.67
GY	6	20.00
HB	3	10.00
US	6	20.00
US+HE	1	3.33

GIS-Gastro-Intestinal; GY- Gynecological; HB- Hepato-Biliary; HE- Hernia; US- Unspecified type of previous surgery.

Table 5. Classification of Subjects Based on Duration since Previous Surgery (n=30)

Duration	No. of surgery	Percentage (%)
0-5 years	15	50.00
06-10 years	4	13.33
11-15 years	1	3.33
16-20 years	2	6.67
21-25 years	2	6.67
26-30 years	3	10.00
31-35 years	3	10.00

Table 6. Average Spectrum of PAI Ranging Between 0 and 5

Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	0.67	0.82	0.00	2.00	2.00	0.33
Epigastrium	0.67	0.52	0.00	1.00	1.00	0.21
Left upper	0.00	0.00	0.00	0.00	0.00	0.00
Left flank	0.00	0.00	0.00	0.00	0.00	0.00
Left lower	0.00	0.00	0.00	0.00	0.00	0.00
Pelvic	0.67	1.21	0.00	3.00	3.00	0.49
Right lower	0.00	0.00	0.00	0.00	0.00	0.00
Right flank	0.33	0.82	0.00	2.00	2.00	0.33
Central	0.50	0.55	0.00	1.00	1.00	0.22
Bowel to Bowel	0.67	0.52	0.00	1.00	1.00	0.21

ANOVA					
Source of Variation	SS	MS	F	P-value	F crit
Between Groups	48853.11	4885.31	16.80	0.00	2.01
Within Groups	15995.37	290.82			
Total	64848.48				

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean SS-Sum of squares; MS-Mean sum of squares; F-'F' value; F Crit-F critical value

Average spectrum of PAI ranging between 11 and 15 is presented in Table 8. Maximum mean Adhesive grade score i.e. 2.33 ± 0.58 was seen in Central region followed by Bowel to Bowel region which contributed to 2.00 ± 2.00 index in total PAI lying between 11 and 15. Left lower region contributed to minimum mean Adhesive score of 0.33 ± 0.58 .

Analysis of variance resulted that the difference between groups was observed to be significant as the P Value (0.00) was lower than 0.05 and F value (44.36) was greater than F critical value (2.30) at 5% level of significance.

In our study, 2 patients were found having PAI between 11 and 15 in which more common adhesions were observed in

Table 7. Average Spectrum of PAI Ranging Between 6 and 10

Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	0.67	0.82	0.00	2.00	2.00	0.33
Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	0.10	0.45	0.00	2.00	2.00	0.10
Epigastrium	0.80	0.95	0.00	2.00	2.00	0.21
Left upper	0.20	0.62	0.00	2.00	2.00	0.14
Left flank	0.00	0.00	0.00	0.00	0.00	0.00
Left lower	0.15	0.49	0.00	2.00	2.00	0.11
Pelvic	1.50	0.95	0.00	3.00	3.00	0.21
Right lower	0.50	0.83	0.00	2.00	2.00	0.18
Right flank	0.40	0.88	0.00	3.00	3.00	0.20
Central	1.60	0.88	0.00	3.00	3.00	0.20
Bowel to bowel	1.90	0.45	1.00	3.00	2.00	0.10
ANOVA						
Source of Variation	SS	MS	F	P-value	F crit	
Between Groups	165250.23	16525.02	180.85	0.00	1.88	
Within Groups	19097.18	91.37				
Total	184347.42					

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean
SS-Sum of squares; MS-Mean sum of squares; F-'F' value; F Crit-F critical value

Central region.

Average spectrum of PAI ranging between 16 and 20 is presented in Table 9. Right Upper Region contributed 2.00, Epigastrium Region contributed 2.00, Left upper Region contributed 2.00, Left flank Region contributed 2.00, Left lower Region contributed 2.00, Pelvic Region contributed 2.00, Right lower Region contributed 2.00, Right flank Region contributed 2.00, Central Region contributed 2.00 and Bowel to bowel Region contributed 2.00 index to the PAI lying between 16-20. (Table 9)

In our study, only 1 patient was found having PAI between 16 and 20 in whom similar adhesions were observed in all of the regions.

The patients with GIS as previous surgery had mean PAI 9.56 ± 4.23 , ranging between 6.00 and 20.00 (range=14.00) and SEM 1.27 followed by the patients with GY as previous surgery, who had mean PAI 7.33 ± 1.63 , ranging between 6.00 and 10.00 (range=4.00) and SEM 0.67. (Table 10)

Chi square test analysis of variance resulted that the difference between groups was observed to be non significant (P value > 0.05).

In our study the patients with different type of previous surgeries had equal adhesions.

Between the patients of various number of previous surgery, patients with one previous surgery had mean PAI 7.81 ± 3.50 ranging between 3.00 and 20.00 (range=17.00) and SEM 0.69. The patients with two previous surgeries had mean PAI 4.25 ± 1.26 ranging between 3.00 and 6.00 (range=3.00) and SEM 0.63.

The t-test findings resulted that pooled variance remained 11.10 and that the difference in mean PAI between patients with two natures of previous surgeries the patients under present study was observed to be significant as the P Value (0.03) was lower than 0.05 and t value (1.99) was higher than t critical value (1.70) at 5% level of significance.

Table 8. Average Spectrum of PAI Ranging Between 11 and 15

Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	1.00	1.00	0.00	2.00	2.00	0.58
Epigastrium	1.33	1.15	0.00	2.00	2.00	0.67
Left upper	0.67	1.15	0.00	2.00	2.00	0.67
Left flank	0.67	1.15	0.00	2.00	2.00	0.67
Left lower	0.33	0.58	0.00	1.00	1.00	0.33
Pelvic	2.00	0.00	2.00	2.00	0.00	0.00
Right lower	0.67	1.15	0.00	2.00	2.00	0.67
Right flank	1.00	1.00	0.00	2.00	2.00	0.58
Central	2.33	0.58	2.00	3.00	1.00	0.33
Bowel to bowel	2.00	0.00	2.00	2.00	0.00	0.00
ANOVA						
Source of Variation	SS	MS	F	P-value	F crit	
Between Groups	23043.29	2304.33	44.36	0.00	2.30	
Within Groups	1142.86	51.95				
Total	24186.15					

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean
SS-Sum of squares; MS-Mean sum of squares; F-'F' value; F Crit-F critical value
Bowel to bowel

Table 9. Average Spectrum of PAI Ranging Between 16 and 20

Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	2.00	-	2.00	2.00	0.00	-
Epigastrium	2.00	-	2.00	2.00	0.00	-
Left upper	2.00	-	2.00	2.00	0.00	-
Left flank	2.00	-	2.00	2.00	0.00	-
Left lower	2.00	-	2.00	2.00	0.00	-
Pelvic	2.00	-	2.00	2.00	0.00	-
Right lower	2.00	-	2.00	2.00	0.00	-
Right flank	2.00	-	2.00	2.00	0.00	-
Central	2.00	-	2.00	2.00	0.00	-
Bowel to bowel	2.00	-	2.00	2.00	0.00	-
ANOVA						
Source of Variation	SS	MS	F	P-value	F crit	
Between Groups	7363.64	736.36	65535.00	-	-	
Within Groups	0.00	65535.00				
Total	7363.64					

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean
SS-Sum of squares; MS-Mean sum of squares; F-'F' value; F Crit-F critical value

Table 10. Type of Previous Surgery and its Association with Intra-Operative Peritoneal Adhesion Index. (n=30)

Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	2.00	-	2.00	2.00	0.00	-
Parameters	Mean	SD	Min.	Max.	Range	SEM
GIS	9.56	4.23	6.00	20.00	14.00	1.27
GIS+GIS	4.00	-	4.00	4.00	0.00	-
GIS+GY	4.50	2.12	3.00	6.00	3.00	1.50
GY	7.33	1.63	6.00	10.00	4.00	0.67
HB	3.33	0.58	3.00	4.00	1.00	0.33
US	7.17	1.60	6.00	10.00	4.00	0.65
Chi square test						
Chi square	P Value					
4.965	0.420					

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean

Table 11. Numbers of Previous Surgery and Its Association with Intra-Operative Peritoneal Adhesion Index. (n=30)

Regions	Mean	SD	Min.	Max.	Range	SEM
Right Upper	1.00	1.00	0.00	2.00	2.00	0.58
Parameters	Mean	SD	Min.	Max.	Range	SEM
One	7.81	3.50	3.00	20.00	17.00	0.69
Two	4.25	1.26	3.00	6.00	3.00	0.63

Statistical Parameters	Pooled Variance	t Stat	P(T<=t) one-tail	t Critical one-tail	P(T<=t) two-tail	t Critical two-tail
Findings	11.10	1.99	0.03	1.70	0.06	2.05

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean t-Student t value

In our study, patients with one previous surgery had higher adhesions than those with two surgeries. (Table 11)

The patients with previous surgery of elective nature had mean PAI 6.50 ± 2.39 ranging between 3.00 and 10.00 (range=7.00) and SEM 0.69. The patients with previous surgery of emergency as well as elective nature had mean PAI 4.25 ± 1.26 ranging between 3.00 and 6.00 (range=3.00) and SEM 0.63. The patients with previous surgery of emergency nature had mean PAI 8.93 ± 3.97 ranging between 6.00 and 20.00 (range=14.00) and SEM 1.06. (Table 12)

Analysis of variance resulted that the difference between groups was observed to be significant as the P Value (0.03) was lower than 0.05 and F value (4.06) was greater than F critical value (3.53) at 5% level of significance.

In our study, patients with previous surgery of emergency nature had highest and than those of emergency as well as elective nature had lowest adhesions.

The patients with abdominal scars of Pfannenstiel incision had mean PAI 8.00 ± 0.00 ranging between 8.00 and 8.00 (range=0.00) and SEM 0.00. The patients with Midline abdominal scars had mean PAI 8.47 ± 3.58 ranging between 6.00 and 20.00 (range=14.00) and SEM 0.82. The patients with abdominal scars Midline as well as another Midline had mean PAI 4.00 ± 0.00 ranging between 4.00 and 4.00 (range=0.00) and SEM 0.00. (Table 13)

Analysis of variance resulted that the difference between groups was observed to be non-significant as the P Value (0.15) was higher than 0.05 and F value (1.79) was greater than F critical value (2.53) at 5% level of significance.

Amongst patients abdominal scars of previous surgery under present study had equal adhesions.

Discussion

Adhesions following surgery represent a major unsolved problem. They occur after 50% to 100% of all surgical interventions in the abdomen and can complicate the work of the surgeon considerably.

In present study out of 30 subjects, maximum number of patients i.e. 6 (20%) belonged to 21-30 years of age group followed by 5 patients each in 31-40 years and 41-50 years of age

Table 12. Nature of Previous Surgeries and its Association with Intra-Operative Peritoneal Adhesion Index (n=30)

Parameters	Mean	SD	Min.	Max.	Range	SEM
Elective	6.50	2.39	3.00	10.00	7.00	0.69
Emergency + Elective	4.25	1.26	3.00	6.00	3.00	0.63
Emergency	8.93	3.97	6.00	20.00	14.00	1.06

ANOVA					
Source of Variation	SS	MS	F	P-value	F crit
Between Groups	81.99	40.99	4.06	0.03	3.35
Within Groups	272.68	10.10			
Total	354.67				

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean SS-Sum of squares; MS-Mean sum of squares; F-'F' value; F Crit-F critical value

Table 13. Abdominal Scars the Patient Surgery and Its Association with Intra-Operative Peritoneal Adhesion Index (n=30)

Parameters	Mean	SD	Min.	Max.	Range	SEM
Pfannenstiel incision	8.00	-	8.00	8.00	0.00	-
Grilde iron	8.00	1.73	7.00	10.00	3.00	1.00
Grilde Iron + Pfannenstiel incision	4.33	1.53	4.00	6.00	2.00	0.88
Midline	8.47	3.58	6.00	20.00	14.00	0.82
Midline + Midline	4.00	-	4.00	4.00	0.00	-
Port Scar	3.00	-	3.00	3.00	0.00	-
Right rooftop	3.50	0.71	3.00	4.00	1.00	0.50

ANOVA					
Source of Variation	SS	MS	F	P-value	F crit
Between Groups	112.76	18.79	1.79	0.15	2.53
Within Groups	241.90	10.52			
Total	354.67				

SD-Standard deviation; Min-Minimum; Max-Maximum; SEM-Standard error of mean SS-Sum of squares; MS-Mean sum of squares; F-'F' value; F Crit-F critical value

group. Duron et al (2006) reported of recurrences of intra-operative peritoneal adhesion up to the age <40 years. In present study recurrences of intra-operative peritoneal adhesion was observed between the below 21 years to above 70 years. Most of the intra-operative case were observed between the age 41 and 50 which is in agreement with the findings of Duron et al (2006) (7).

Weibel and Majnocrrespondence, (1973) reported that age did not affect the incidence of postoperative adhesions, but there was an increase of spontaneous adhesions after the age of sixty (8).

The present study observed that post surgical adhesions were more common in patients with history of one previous surgery. Contrary to the findings of our study, DeCherney and DiZerega, (1997) reported that the problem of postsurgical adhesions to health care delivery increases with the patient's age, the number of laparotomies (9).

Weibel and Majnocrrespondence (1973) reported that the incidence of adhesions after minor, major, and multiple operations was 51, 72, and 93 per cent, respectively (8).

In present study out of 30 subjects, majority of the patients

i.e. 19 (63.33%) had midline scar mark of previous surgery followed by Grid iron type which contributed to 10.00% of study subjects and only 1 patient reported with Pfannenstiel incision scar mark.

While interpreting types of previous surgeries, it was found in present study that maximum number of study subjects i.e. 11(36.67%) presented with history of gastrointestinal type of surgery. 6(20.00%) patients came with history of Gynecological type of surgery. Only 1 patient each presented with history of twice gastrointestinal surgery and US+HE type of surgery.

Parker et al (2001) reported in their study that cohort 32.6 per cent of patients were readmitted a mean of 2.2 times for a potential adhesion-related problem. After open lower abdominal surgery out of 8,861, 643 readmissions were directly related to adhesions (10). A study done by Coleman et al (2000) in United Kingdom to study the effect of previous surgery on the time taken to reoperate. They stated that 51% of elective and 71% of emergency cases had previous abdominal surgery (11).

Kossi et al (2004) in their study found that among all the patients of adhesive small bowel obstruction 15% had colorectal surgeries, 49% upper abdominal surgeries, 35% gynecological surgeries, 15% mid-abdominal surgeries 9%, abdominal wall surgeries and 8 % urological surgeries (12). A study done by Cox M.R et al (1993) in Australia to identify the operative procedures and type of adhesions that causes small bowel obstruction. It was observed that appendicectomy (23.3%) was the most common cause of post operative adhesions followed by colorectal resection (20.8%) (13).

In present study out of 30 subjects, 14 (46.67%) study subjects had emergency nature of previous surgery (EMR) followed by 12 (40.00%) who had elective nature of previous surgery and 4 (13.33%) subjects had emergency as well as elective (EMR+Elective) nature of previous surgery.

Similar findings were reported by Bologna Guidelines for diagnosis and management of Adhesive Small Bowel Obstruction (ASBO) published in 2011 stated that incidence rate for abdominal adhesions have been estimated to be as high as 94 to 95% after emergency laparotomy (14).

In present study out of 30, half i.e. 15 (50.00%) of patients had 0-5 years duration since previous surgery followed by 4 (13.33%) who underwent surgery 06-10 years back. Minimum number i.e. 1(3.33%) patient presented with post operative adhesive intestinal obstruction had undergone surgery 11-15 years back.

Similar to findings of present study Ellis (1997) reported that during follow-up of over 2,000 laparotomies at the Westminster Hospital demonstrated that 1% of patients developed adhesive obstruction within one year of surgery, and half of these occurred within the first postoperative month. However, obstruction may occur at any time, and some 20% of cases appeared more than 10 years later (15).

Parker et al (2001) reported in their study that cohort 32.6 per cent of patients were readmitted in the subsequent ten years for a potential adhesion-related problem. After open lower abdominal surgery 7.3 per cent of readmissions were directly related to adhesions (10).

Menzies and Ellis (1990) reported that the recurrences of postoperative adhesion from one month to period of more than 10 years or unknown period. In present study the recurrences of postoperative adhesions from 0 to 40 years (16).

As far as our knowledge there is limited published literature on association of clinical profile of patients with post operative Adhesive Intestinal Obstruction with Intra-operative Peritoneal Adhesive Index. So correlation of findings of present research work in relation to PAI with other studies couldn't be done.

In this study, it was observed that adhesions over each abdominal region contributed equal to the total PAI as our results of which the total PAI was not significant.

It was also observed that out of 30 patients, 6 patients with PAI ranging between 0 and 5, predominantly had Bowel to Bowel adhesion and adhesion over Pelvic and Epigastrium region. It was also observed that in 21 out of 30 patients with PAI between 6 and 10, bowel to bowel the adhesions were predominant. It was also observed that in 2 out of 30 patients with PAI between 11 and 15 central region adhesions were predominant. Further in the patients having PAI ranging between 16 and 20, it was observed that only one patient with comparatively similar adhesions in each region.

On studying association between age of patient undergoing surgery and Intra-operative PAI, it was observed that the age distribution showed that patient belonging to age group of 41 to 50 years had highest adhesions while the lowest adhesions value were observed in the patients in the age group 51 to 60 years.

Analysis of variance resulted that the difference between groups was observed to be significant ($P < 0.05$).

In this study the distribution of patients with respect to the type of previous surgery performed showed that patients undergoing GIS had higher adhesions than that of patients undergoing HB. The difference was statistically not significant ($P > 0.05$).

It was also observed that patients with previous history of a single surgery had greater number of adhesions than those patients who had history of undergoing more than one surgery and the difference in mean PAI between patients with two nature of previous surgeries was statistically significant ($P < 0.05$).

In this study it was observed that the patient with different durations of previous surgery having equal adhesions in respective regions as the difference was statistically not significant ($P > 0.05$).

In this study it was observed that the patients who had previous emergency surgery had higher incidence of adhesions, than elective surgery whereas those patients who underwent both elective and emergency surgeries, the incidence of adhesions were lowest. The difference was statistically significant ($P < 0.05$).

Analysis of variance with respect to abdominal scar resulted that the difference between groups was observed to be statistically not significant ($P > 0.05$), so patients with all type of abdominal scars of previous surgeries has equal chance of developing adhesions.

Conclusion

Peritoneal adhesive index (PAI) is a way to effectively evaluate patients with adhesive bowel obstruction and to compare their condition to past evaluation. The indexing is based on the macroscopic appearances of adhesions and their extent to different areas of the abdomen. All of the regions have equal possibilities of adhesions and therefore contribute equally in total PAI.

PAI is a sensitive tool for clinical and intra-operative assessment of adhesive intestinal obstruction for the quantification of the adhesions and gives a precise description of the underlying intra-abdominal condition while planning a surgical management of the disease.

References

1. Diamond MP, El-Hammady E, Wang R, Kruger M, Saed G. Regulation of expression of tissue plasminogen activator and plasminogen activator inhibitor-1 by dichloroacetic acid in human fibroblasts from normal peritoneum and adhesions. *Am J Obstet Gynecol*. 2004 Apr; 190(4):926–34.
2. DiZerega G.S. Contemporary adhesion prevention. *Fertil Steril*. 1994 Feb; 61(2):219–35.
3. Brugmann D, Tchartchain G, Wallweiner M, Munstedt K, Tinneberg H-R, Hazkethal A. Intra- abdominal Adhesions: Definition, Origin, Significance in Surgical Practice and Treatment options. *Dtsch Arztebl Int*. 2010 Nov; 107(44): 769–775.
4. Liakakos T, Thomakos N, Fine P.M, Derveniz C, Young R.L. Peritoneal Adhesions: Etiology, Pathophysiology, and Clinical Significance. *Dig Surg*. 2001 Aug; 18(4):260–73.
5. Arung W, Meurisse M, Detry O. Pathophysiology and prevention of postoperative peritoneal adhesions. *World J Gastroenterol*. 2011 Nov 7; 17(41):4545-53.
6. Coccolini F, Ansaloni L, Manfredi R, Campanati L, Poiasina E, Bertoli P, Capponi MG, Sartelli M, Saverio SD, Cucchi M, Lazzareschi D, Pisano M, Catena F. Peritoneal adhesion index (PAI): proposal of a score for the “ignored iceberg” of medicine and surgery. *World J Emerg Surg*. 2013 Jan 31;8(6):1-5.
7. Duepre H.J, Anthony J, Senagore A.J, Delaney C.P, Fazio V.W. Does means of access affect the incidence of small bowel obstruction and ventral hernia after bowel resection? Laparoscopy versus laparotomy. *J Am Coll Surg*. 2003 Aug; 197(2):177-81.
8. Weibel MA, Majnoco, G. Peritoneal adhesions and their relation to abdominal surgery. *The American Journal of Surgery*. 1973 Sept; 126(3):345–53.
9. DeCherney AH, diZerega GS. Clinical problem of intra-peritoneal postsurgical adhesion formation following general surgery and the use of adhesion prevention barriers. *Surgical Clinics of North America*. 1997 Jun 1; 77(3):671–88.
10. Parker M.C, Ellis H, Moran B.J, Thompson J.N, Wilson M.S, Menzies D et al. Postoperative adhesions: ten-year follow-up of 12,584 patients undergoing lower abdominal surgery. *Dis Colon & Rectum*. 2001 Jun; 44(6):822-29.
11. Coleman M.G, McLain A.D, Moran B.J. Impact of previous surgery on time taken for incision and division of adhesions during laparotomy. *Dis Colon Rectum*. 2000 Sep; 43(9):1297-99.
12. Kossi J, Salminen P, Laato M. The Epidemiology and Treatment Patterns of Postoperative Adhesion Induced Intestinal Obstruction in Varsinais-Suomi Hospital District. *Scandinavian Journal of Surgery*, 2004; 93:68–72.
13. Cox M.R, Gunn I.F, Eastman M.C, Hunt R.F, Heinz A.W. The operative aetiology and type of adhesions causing small bowel obstruction. *Aust N Z J. Surg*. 1993 Nov; 63(11):848-52.
14. Catena F, Di Saverio S, Kelly M.D, Biffi W.L, Ansaloni L, Mandala V et al. Bologna Guidelines for Diagnosis and Management of Adhesive Small Bowel Obstruction (ASBO): 2010 Evidence-Based Guidelines of the World Society of Emergency Surgery. *World J Emerg Surg*. 2011 Jan 21; 6:5.
15. Ellis H. The clinical significance of adhesions: focus on intestinal obstruction. *Eur J Surg Suppl*. 1997; 577:5-9.
16. Menzies D, Ellis H. Intestinal obstruction from adhesions how big is the problem? *Ann R Coll Surg Engl*. 1990;72(1):60-3.