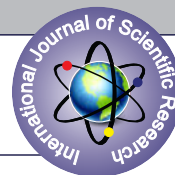


INCISIONAL HERNIA-A COMPARATIVE STUDY OF RISKS FACTORS, CLINICAL PRESENTATION AND PRE-PERITONEAL POLYPROPYLENE MESH REPAIR IN A TERTIARY CARE HOSPITAL IN ODISHA



General Surgery

Dr. Soubhagya Ranjan Tripathy	Assistant Professor,dept.of General Surgery Hitech Medical College And Hospital, bhubaneswar.
Dr. Baidya Nath Sadhu*	Junior Resident, Dept. Of General Surgery Hitech Medical College And Hospital Bhubaneswar. *Corresponding Author
Dr. Binaya Kumar Padhi	Junior Resident Dept. Of General Surgery Hitech Medical College And Hospital Bhubaneswar.
Dr. Lipsha Swain	Junior Resident, Dept. Of General Surgery Hitech Medical College And Hospital Bhubaneswar.

ABSTRACT

Background: Incisional hernia is a common surgical condition encountered in day to day practice. It is most often seen in obese individuals. Based on national operative statistics, incisional hernias account for 15% to 20% of all abdominal wall hernias. Of all hernias encountered, incisional hernias can be the most frustrating and difficult to treat. Incisional hernias occur as a result of excessive tension, postoperative abdominal distension and inadequate healing of a previous incision, which is often associated with surgical site infection, persistent postoperative cough, infection. Several technical and patient-related factors have been linked to the occurrence of incisional hernias. There is no conclusive evidence that demonstrates that the type of suture or technique of incisional closure at the primary operation affects hernia formation.⁴⁵

Primary repair of incisional hernias can be done when the defect is small (≤ 2 cm in diameter) and there is viable surrounding tissue. Larger defects (>2.3 cm in diameter) have a high recurrence rate if closed primarily and are repaired with a prosthesis.

Recurrence rates vary between 10% and 50% and are typically reduced by more than half with the use of prosthetic mesh. Prosthetic material may be placed as an onlay patch to buttress a tissue repair, interposed between the fascial defect, sandwiched between tissue planes, or put in an intraperitoneal position. Depending on its location, several important properties of the mesh must be considered.

As many factors contribute to formation of incisional hernia, which can occur at the site of any type of abdominal surgery previously performed on a wide range of individuals, there is no outstanding profile of an individual most likely to have an incisional hernia. Men, women, and children of all ages and ethnic backgrounds may develop an incisional hernia after abdominal surgery.

This study is an effort to evaluate the risk factors, clinical presentations & polypropylene mesh repair (pre peritoneal) management of Incisional hernia.

Aims and Objectives

1. To study clinical presentation of Incisional Hernia.
2. To study the risk factors involved in formation Incisional Hernia.
3. To develop a strategy for an effective management of Incisional Hernia with Preperitoneal mesh repair technique using polypropylene mesh.

Methods: Patients admitted in various surgical wards of Hitech Medical College And Hospital, Bhubaneswar, having Incisional Hernia are included in our study. A total number of 50 patients have been studied. The study was conducted during the period from December 2019 to August 2021. Patients which were unfit for surgery, with recurrent hernias, Strangulated and Incarcerated Incisional Hernia and pregnancy have not been included in the study.

In all the above mentioned patients pre peritoneal mesh repair was done for the hernia repair and patients were regularly followed for up to 2 years post surgery.

Results: Incisional hernia is more common in the obese patients and in middle aged females. Common risk factors responsible for the incisional hernia are post op infection, obesity and multiparity. Most of the patients had incisional hernia within a year of previous surgery.

Conclusions: In this study the following conclusions were made

- Females are more prone to get incisional hernia (2.1:1)
- Most of the patients had presenting complaint of abdominal swelling with cough impulse and reducible on lying supine.
- Most of the Incisional hernias occurred within a year of previous surgery.
- Common risk factors for the development of incisional hernia were obesity, post op infections and multiparity.

KEYWORDS

INTRODUCTION

Incisional hernia is a major health care problem. It is one of the most frequent long term complications of abdominal surgery and it continues to be a significant problem for patients as well as surgeons. As a result of advances in surgical knowledge and increase in the variety and number of abdominal incisions, the incidence of postoperative incisional hernias has increased rapidly. Unfortunately, attempts of repair these hernias have not been uneventful, with high rates of hernia recurrence, and considerable rates of morbidity and mortality, making many surgeons hesitant to undertake incisional hernia repair. On the other hand, however, delay in repair may have serious clinical consequences. Apart from discomfort and pain, incisional hernias may predispose to incarceration or strangulation of primarily small bowel, which is almost certainly fatal if not promptly reduced. Also, as a consequence of the impact on health, incisional hernias have enormous economic consequences. At this time no consensus has been reached about whether, how, and when to operate on a patient with an incisional hernia. To solve the incisional hernia problem, first of all methods of prevention are needed. Furthermore,

once an incisional hernia has developed, ideally, methods of repair that do not lead to recurrence or other complications should be available.

This prospective study looks into various risk factors involved in the formation of incisional hernia, its clinical presentation and preperitoneal polypropylene mesh repair.

50 patients admitted in various surgical wards of Hitech Medical College and Hospital, Bhubaneswar have been included in the study.

AIMS AND OBJECTIVES

1. To study clinical presentation of Incisional Hernia.
2. To study the risk factors involved in formation Incisional Hernia.
3. To study the management of Incisional Hernia with Preperitoneal mesh repair technique using polypropylene mesh.

METHODOLOGY

Patients admitted in various surgical wards of, Hitech Medical College and Hospital, Bhubaneswar having Incisional Hernia are included in our study by applying the following inclusion & exclusion criteria. The

study was conducted during the period from December 2019 to August 2021 an total number 50 cases were taken for study.

Patient selection for the study has been on random basis.

INCLUSION CRITERIA FOR THE STUDY:

- 1 All patients with Incisional Hernia between 8 to 70 years
2. Both the sexes.

EXCLUSION CRITERIA:

1. Patients with uncontrolled Diabetes mellitus and COPD
2. Recurrent Incisional Hernia
3. Strangulated and Incarcerated Incisional Hernia
4. Pregnancy with Incisional Hernia

All the patients were inquired about the duration of hernia, progression and the main associated symptoms like pain, vomiting, cough, dysuria, reducibility of the swelling, association with pregnancy. Past history pertaining to previous surgery- its nature, duration, type of surgery and closure was recorded. Patients were also asked about the complications associated with previous surgery like infections. Recording about the scar of the previous surgery, the hernia defect – its position, size, shape, cough impulse, reducibility and the overlying skin over the defect were made.

Other comorbidities like anaemia, jaundice, hypertension, hypoproteinemia, obesity, benign prostatic hypertrophy were recorded.

Chest screening was done to rule out COPD.

Multiparity was recorded for female patients with more than 2 children. If patient was found to have ascites, Ultrasound abdomen was done.

Data was collected from a specially designed case recording Proforma (CRF) pertaining to patient's particulars, proper history, clinical examinations, investigations, diagnosis & surgical procedures, infection following surgery, length of stay in the hospital.

Following PRE OPERATIVE INVESTIGATIONS were done and recorded for all the patients

Hb%, Random blood sugar, urea, Serum Creatinine, Chest Xray, ECG and Ultrasound abdomen (when indicated).

Pre surgery work up constituted – Informed consent, NPO a night before the surgery, Inj Cefotaxime 1 gm IV stat immediately before the surgery (as preoperative antibiotic), Inj. tetanus toxoid .5 cc IM and indwelling urinary catheterization.

PROCEDURE

Under general/Spinal anesthesia, parts were painted and draped.

Incision (Vertical or transverse) was taken enclosing the previous scar and the previous scar was excised. Abdomen was opened in layers. The hernia sac was identified and dissected. Sac was opened and if adhesions were present between the bowel/omentum and the sac, it was released. The content of the sac was reduced after adhesiolysis. The redundant sac wall was excised. A plane was created between the peritoneum and the posterior rectus. Hemostasis was achieved in the layer. The peritoneum along with the sac was closed with vicryl No. 2.0. Prolene mesh (larger than the size of defect) was placed over the closed peritoneum, under the posterior rectus and secured to the musculo aponeurotic layer by taking "U" bites with prolene No. 2.0. A negative suction drain (Romovac) was kept over the mesh and was brought outside through a stab incision in the anterior abdominal wall. Closure of the rectus was done with Prolene No. 1 in continuous fashion. Another negative suction drain was kept over this layer, and brought outside through a stab incision. Excess redundant subcutaneous layer was excised. The subcutaneous layer was closed with Vicryl No. 2.0 in intermittent manner. The surgical site was painted with Povidone iodine lotion (5% strength). Closure of skin was done with Ethilon No 2.0 intermittently. The drainage tubes were secured with purse string sutures.

All the patients were kept NPO for up to 6 hours after surgery, following which oral feed was allowed.

Patients were given parenteral antibiotics (Cefotaxime 1.0 gm BD), analgesics and Proton pump inhibitors (Pantoprazole 40 mg I.V. OD)

Daily drain output was monitored and recorded. Drains were removed on 5th to 6th post-operative day, after the output was significantly low. Alternate day dressing was done for the surgical site and it was monitored for surgical site infection. In case of infection and purulent discharge, the collection was let out by removing a stitch and pus specimen was collected for culture and sensitivity.

Post-operative infection in the study was defined as presence of purulent discharge, tenderness and erythema of greater than 1 cm margin. Seroma was defined as collection of serous liquid. Hematoma was defined as collection of frank blood.

Skin necrosis was defined as blackening of the skin on the edge of the wound.

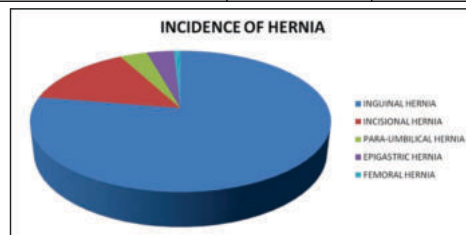
Suture removal was typically done on post op day 9. In case of surgical site infection, the sutures were retained for additional 4 to 5 days.

Recurrence was defined as reappearance of Incisional hernia following complete healing of the wound of the surgery.

Patients were discharged after suture removal, with the advice to refrain from heavy strenuous work and were called for follow up at a regular interval. During follow up patients underwent regular general checkup and the surgical site was examined for recurrence of hernia.

Table 1 Incidence Of Incisional Hernia Is As Follows

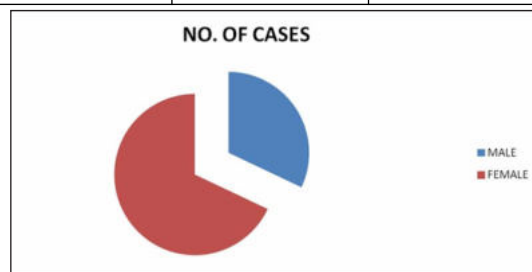
TYPE OF HERNIA	No. OF CASES	PERCENTAGE
INGUINAL HERNIA	267	77.61
INCISIONAL HERNIA	50	14.53
PARA-UMBILICAL HERNIA	12	3.48
EPIGASTRIC HERNIA	12	3.48
FEMORAL HERNIA	3	0.87



The study shows that incidence of incisional hernia is 14.53 % (amongst other hernia) and incisional hernia is second most common type of hernia, most common being Inguinal hernia.

Table 2 Sex Distribution Of Incisional Hernia

SEX	NUMBER	PERCENTAGE
MALE	16	32
FEMALE	34	68

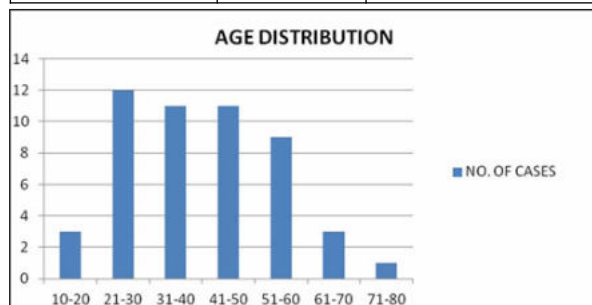


This study shows that incisional hernia is more common in females than males with Female to Male ratio 2.1 : 1

Table 3 Age Distribution Of Incisional Hernia

AGE IN YEARS	NO. OF CASES	PERCENTAGE
10-20	3	6
21-30	12	24
31-40	11	22
41-50	11	22

51-60	9	18
61-70	3	6
71-80	1	2

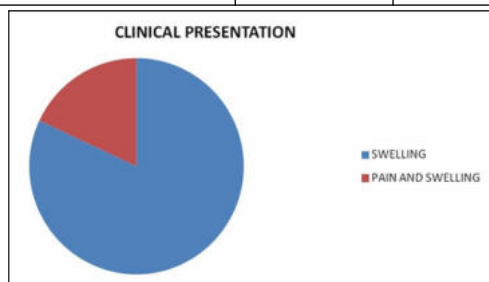


AGE IN YEARS

The study shows that the majority of the patients are in the age between 21 years and 60 years.

Table 4 Clinical Presentation Of Patients

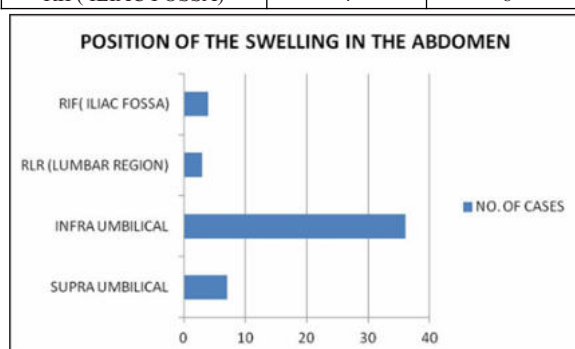
CLINICAL PRESENTATION	NO. OF CASES	PERCENTAGE
SWELLING	50	100
PAIN AND SWELLING	11	22



The study showed that all the patients (100%) presented with swelling in the abdomen. 22% Patients had associated pain in the swelling.

Table 5 Position Of The Swelling In The Abdomen

POSITION OF SWELLING	NO. OF CASES	PERCENTAGE
SUPRA UMBILICAL	7	14
INFRA UMBILICAL	36	72
RLR (LUMBAR REGION)	3	6
RIF(ILIAC FOSSA)	4	8

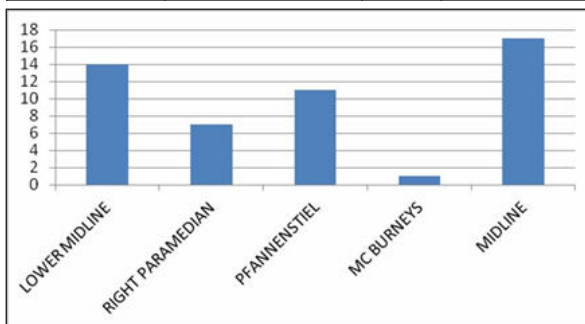


In this study 72 percent of patients presented with infra umbilical swelling, 14 percent presented with supra umbilical swelling, 8 percent with right iliac fossa swelling and 6 percent with right lumbar swelling.

Table 6 Nature And Type Of Previous Incisions (previous Surgery)

TYPE	SURGERY	NO. OF CASES	PERCENTAGE
LOWER MIDLINE	HYSTERECTOMY/CAESERIAN SECTION	14	28
RIGHT PARAMEDIAN	LAPAROTOMY	7	14
PFANNENSTIEL	LSCS	11	22

MC BURNEYS	APPENDICECTOMY	1	2
MIDLINE	LAPAROTOMY	17	34



TYPE OF PREVIOUS INCISIONS

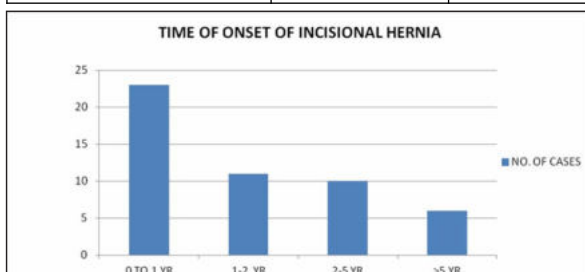
From the study it was concluded that majority of incisional hernia occurred below the umbilicus (50 %).

34 percent of cases had midline incision in previous surgery.

14 percent of the cases had incisional hernia following previous right paramedian incision. Only 2 percent of cases were found with previous McBurney's incision.

Table 7 Time Of Onset Of Incisional Hernia After Previous Surgery

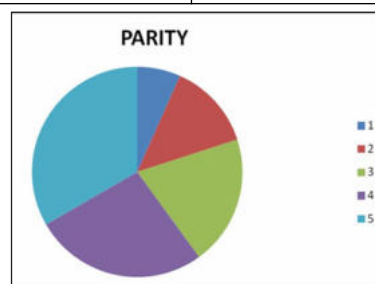
TIME OF ONSET	NO. OF CASES	PERCENT
0 TO 1 YR	23	46
1-2 R	11	22
2-5 YR	10	20
>5 YR	6	12



From the above data it is interpreted that 46 percent of the patients presented with incisional hernia within a year of previous surgery. 22 percent of patients presented between 1 to 2 years. Another 20 percent in 3 to 5 years of the previous surgery. While only 12 percent of patients presented after 5 years of previous surgery.

Table 8 Obstetric History (31 Patients)

PARITY	No. OF CASES
1	5
2	10
3	11
4	4
5	1

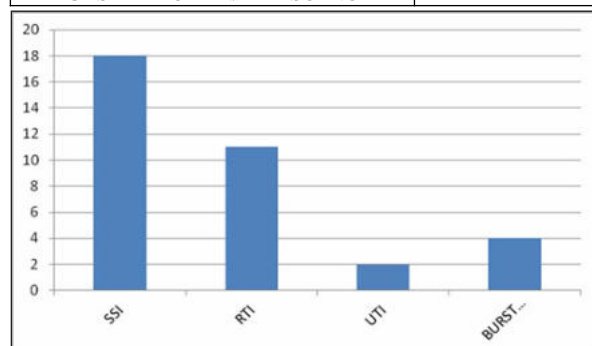


Out of 31 patients, more than 50 percent had three or more children.

Table 9 Post Operative Complications Of Previous Surgery

COMPLICATION	No. OF CASES
SSI	18
RTI	11

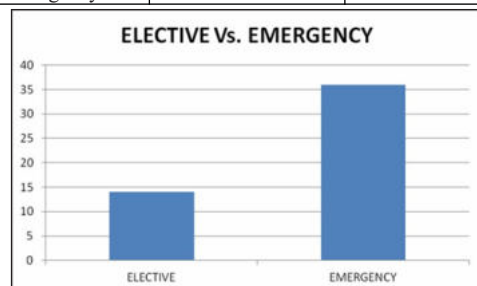
UTI	2
BURST ABDOMEN/DEHISCENCE	4



This study showed that 18 patients has surgical site infection, 11 patient had respiratory tract infection, 4 patient had wound dehiscence and 2 patients had Urinary tract infection in the post- operative period of previous surgery.

Table 10 Elective Vs. Emergency Surgery

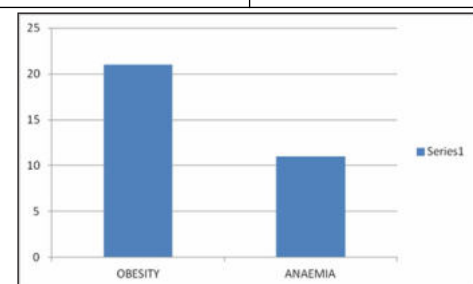
TYPE	No. OF CASES	PERCENT
Elective	14	28
Emergency	36	72



In this study 72 percent of the patients who underwent the previous surgery on an emergency basis had incisional hernia.

Table 11 Risk Factors

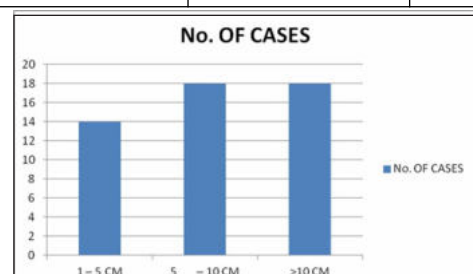
RISK FACTOR	NUMBER OF CASES
Obesity	21
Anaemia	11



The most common risk factor was obesity in this study.

Table 12 Size Of Hernial Defect

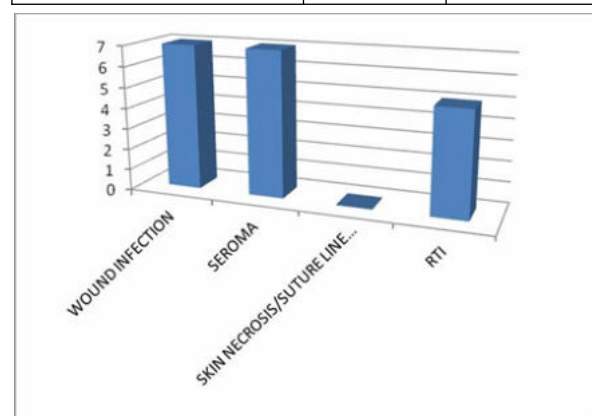
SIZE OF DEFECT	No. OF CAS	PERCE NT
	ES	
1 – 5 CM	14	28
5-10 CM	18	36
>10 CM	18	36



28 Percent of the patient had a defect size of less than 5 cm, 36 percent patients had a defect size of 5 – 10 cm and the rest had a defect size of greater than 10 cm.

Table 13 Post Operative Complications

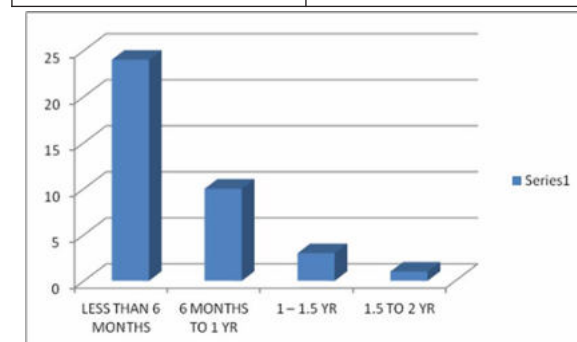
COMPLICATION	No. OF CASES	PERCENTAGE
WOUND INFECTION	7	14%
SEROMA	7	14%
SKIN NECROSIS/SUTURE LINE NECROSIS	0	0
RTI	5	10%



In the study 7 patients had surgical site infection and 7 patients had seroma formation. 5 patients had Respiratory tract Infection.

Table 14 Period Of Follow Up

PERIOD	No. OF CASES
LESS THAN 6 MONTHS	24
6 MONTHS TO 1 YR	10
1 – 1.5 YR	3
1.5 TO 2 YR	1



Almost half the patients in the study group were followed for complications, including recurrence. 10 patients were followed up for up to one year duration.

DISCUSSION

In this study a total number of 50 patients with incisional hernia, were admitted in Hitech Hospital and treated with pre peritoneal polypropylene mesh repair from period of December 2019 to August 2021. These patients were evaluated for various risk factors which lead to formation of incisional hernia and its clinical presentation. As the study group is small and it's not a comparative study, it may not reflect all the aspects of incisional hernia.

The incidence of incisional hernia has been stated variously. In 1887 John Himans of Boston reported an incidence of 10percent of incisional hernia in 184 cases of laparotomies. Rodney Maingot reported an incidence of 1 – 14 percent of incisional hernia in patients undergoing Trans peritoneal abdominal operations. In 1933 Cave reported an incidence of 6 percent of incisional hernia in laparotomy wounds (Quoted by Zimmerman 1967).

In this study the incidence of incisional hernia in Hitech Hospital, Bhubaneswar from period of December 2019 to August 2021

has been 14.53 %. The study shows that the majority of the patients are in the age between 21 years and 60 years. Brendan Devlan states that in most series, the incidence is more around 40 years.

The sex incidence of incisional hernia among the cases studied 2.1: 1 (Female: Male), which clearly means that females have higher incidence incisional hernia. The incidence is more in females because of laxity of abdominal muscles due to multiple pregnancies. In males the incidence of incisional hernia is relatively less as most of the surgeries are above the umbilicus, and the strength and integrity of abdominal wall is good because of well-developed muscles and fascia. All the patients under study presented with swelling in the abdomen. 22 % of the patients presented with dragging nature of pain in the swelling. In this study 72 percent of the incisional hernia have occurred in midline infra umbilical incisions. This can be attributed to the fact that posterior rectus is absent below the arcuate line in the lower abdomen. Vertical incisions are under more stress compared to transverse incisions.

Also the intra peritoneal pressure is hydrostatic and in the erect position, the upper abdominal pressure remains at 8 cm of water while the lower abdominal pressure increases to 20 cms of water, with change of posture from recumbency to standing.

In this study 46 % of the patients presented with incisional hernia within a year of previous surgery, and 68% within 2 years of surgery. Only 12 % of patients developed hernia after 5 years of surgery. In Akman's series (1962) more than 65 % of the incisional hernia developed within 1 year of the previous surgery.

In a 10 year prospective trial involving 337 patients, Mudge and Hughes showed that of the 62 patients who developed incisional hernia, 56 % did so after the first post operative year and 35 % manifested hernia after 5 years.

One of the important etiology for incisional hernia is obesity. This study showed that 21 cases (42%) patients of the total 50 were obese. Obesity is associated with 3 fold increase in herniation in Buknell's study. Thus the prevalence of obesity among the patients is clearly established.

Out of 50 cases, 72 % of the cases underwent the previous surgery on an emergency basis. Emergency operations have been identified as a risk factor for wound dehiscence. Study done by Pollock in 1989, where only 1.2 % of the patients operated on elective basis had incisional hernia while 23.9% of the patients operated on emergency basis had incisional hernia. Also study done by Israelsson in 1996 reflected that 9.9 % of the patients who underwent elective surgery had incisional hernia while 15.8 % patients who underwent emergency surgery had incisional hernia.

Out of 31 patients who had incisional hernia, more than 50 percent had three or more children. This clearly shows the association between incisional hernia and multiparity. The incidence of incisional hernia is more in multiparous women due to repeated stretching and laxity of the abdominal muscles. Poor muscle tone can be attributed for the incisional hernia in these cases. Poor muscle tone was especially noted in patients who had 3 or more children.

Diagnosis in all the cases was made by clinical examinations. Ultrasound abdomen was done when necessary.

Patients who were smokers were advised to stop smoking preoperatively for at least a fortnight before the surgery. These patients were also given chest physiotherapy and chest exercises.

Obese patients were advised to reduce weight. Anaemic patients were given supplementation with iron and folic acid, and when necessary blood transfusion was done to build up hemoglobin.

All the patients underwent pre peritoneal polypropylene mesh repair under general/spinal anaesthesia. The content of the sac (small bowel/omentum/colon) was reduced. In a few cases where the omentum was devitalized, it was excised.

The size of hernia defect was recorded meticulously and ranged from 3 cm to >10 cm. 28 % of the patient had a defect size of less than 5 cm, 36 % patients had a defect size of 5 – 10 cm and the rest had a defect size of

greater than 10 cm. All the patients were treated with pre peritoneal poly propylene mesh, irrespective of the size of the defect.

Closed suction drain was kept in patients where extrafascial accumulation of fluid was expected. Daily monitoring of the output was recorded, and the drain was removed when the output was negligible/ nil. In the study 7 patients had seroma formation, 7 patients had surgical site infection and 5 patients had Respiratory tract Infection. Complications were managed conservatively.

All the patients received preoperative antibiotic (cephalosporin) and continued up to 6 days post-operative period.

None of the patients required removal of mesh due to wound infection. There were no cases of mesh extrusion.

Patients were advised to come for regular follow-up. Patients were asked to come on weekly basis for the 1st month and every 3 months after that. Almost half the patients in the study group were followed for complications, including recurrence. 10 patients were followed up for up to year duration.

There were no recurrences of hernia in the follow-up patients.

STUDY	YEAR	No. OF CASES	TYPE OF REPAIR	RECURRENCE
SUTURE TECHNIQUES				
LANGER	1985	21	SUTURE	42.9
GEORGE	1986	12	NYLON	41.6
VDLINDEN	1988	74		20.3
READ	1989	16	PROLENE	43.8
LIAKAKOS	1994	53	NYLON	24.5
MESH TECHNIQUES				
USHER		96	MESH REPAIR	10.6%
READ	1989	20	INTRAPERITONEAL	40
LIAKAKOS	1994	49	INTRA OR PRE PERITONEAL	8.2
THIS STUDY		50	PRE PERITONEAL POLYPROPYLENE MESH REPAIR	NO RECURRENCE

CONCLUSION

- Incisional hernia constituted about 14.53% of total hernias operated in Hitech medical college and hospital from December 2019 to August 2021.
- The incidence of incisional hernia is more common in females than males with Female to Male ratio 2.1: 1
- Incisional hernia is more prevalent in between 2nd and 6th decade with majority of the patients being in the age between 21 years and 60 years.
- All the patients with incisional hernia presented with swelling in the abdomen. Only 22% patients had associated pain in the swelling.
- 72 percent of patients presented with infra umbilical swelling, Cough impulse is present and swelling reduces on lying down (supine position). Majority of incisional hernia is below the umbilicus.
- In 50 % of patients infra umbilical (lower midline or pfannenstiel incision) was used in the previous surgery. Infra umbilical incisions are more prone to hernia development later in life.
- Among females incisional hernia is more common in multiparous women. Out of 31 female patients under study, more than 50 percent had three or more children.
- 46 % of the patients presented with incisional hernia within a year of previous surgery. Almost 70 % cases had incisional hernia within 2 years of previous surgery.
- Patients who underwent emergency surgical intervention previously were more prone to get incisional hernia. In the study 72 percent of the patients who underwent the previous surgery on an emergency basis had incisional hernia.

- Major predisposing factor in the order of frequency are
- Lower abdomen incision
- Multiparity
- Obesity Surgical site infection and wound dehiscence in post op period
- Anaemia
- Common complications seen in the previous surgery were surgical site infection, respiratory tract infection and wound dehiscence. In the study, out of 50 patients 18 patients has surgical site infection, 11 patients had respiratory tract infection, 4 patients had wound dehiscence.
- Size of the defect varied from 3 to >10 cm in diameter. 28 Percent of the patient had a defect size of less than 5 cm, 36 percent patients had a defect size of 5 – 10 cm and the rest had a defect size of greater than 10 cm.
- Among others, the common complications following surgery were seroma formation and surgical site infection. 7 patients had surgical site infection and 7 patients had seroma formation.
- In the study the patients were followed up for up to 1 year 8 months. Almost half the patients were followed up to 6 months. There were no cases of recurrence of incisional hernia in any of the patients.

SUMMARY

In this study, various risk factors, clinical presentation of incisional hernia were evaluated and pre peritoneal polypropylene mesh repair was done for all the cases which were admitted during the period of in Hitech Medical College and hospital, Bhubaneswar. It was found that incisional hernia is the second most common type of hernia in the hospital. It is more common in females, especially the multiparous. Incisional hernia is more common in patients who underwent the previous surgery on an emergency basis.

All the patients present with swelling and pain can be an associated symptom. Cough impulse was present in all the cases and the swelling reduced on lying supine. Over half the patients had undergone the previous surgery within 2 years. Common post op complications in the previous surgery were surgical site infection and respiratory tract infection.

Risk factors associated with incisional hernia are Lower abdomen incision, multiparity, obesity, surgical site infection and wound dehiscence in post op period. Patients with anaemia are more prone to develop Incisional hernia.

Size of the defect can vary, and in our study ranged from 3cm diameter up to >10 cm diameter.

All the patients in the study underwent pre peritoneal polypropylene mesh repair. Seroma formation and surgical site infection were the common complications in the post-operative period. No recurrence was seen in the follow up of the patients.

REFERENCES

1. Ponka- Hernias of Anterior abdominal wall, Saunders Company, 1980
2. Jack Abrahamson "Hernias" 14 TH CHAPTER Rodney Maingot's abdominal Operations 10th Edition 548- 572
3. Mc Arthur L.L, Autoplastic sutures in hernia and other diseases. JAMA, 1901;37:1162
4. Judd E.S. Prevention and treatment of ventral hernia Surg.Gy.Obst 14;175.1972
5. Gibson C. Operation for cure of large ventral hernias. Ann Surgery 72;214-217 August 1920
6. Burton C. Ann Surgery 38;47.1903
7. Hamilton J.E. The repair of large or difficult hernia with mattress onlay graft of fascia lata, Annals of Surg. 169;85,1968
8. Nuttal HCW/ rectus transplantation for midline Incisional hernias BJS,25, 344, 1937
9. Abel A.L. Hunt Stainless steel wire for closing abdominal Incisions and repair of hernia, BMJ 2;379,1948
10. Cattels R.B. Surg clinics of N Am 22;796, 1942
11. Wells CA, hernia, Incisional and umbilical. Ann R. coll. Surg (Engle) 19, 316, 1956
12. Koontz A.R. AND Kimberly R.C. further experimental works on prostheses of hernia repair, Surg Gynae Obst 109,321 : 1959
13. Abraham J.I. and Jonassen O.T. the use of polyvinyl sponge in the repair of abdominal wall hernias. Surgery, 42;336, 1957
14. Thomas A Santora, Joel J. Roslyn. Incisional hernia; surgical clinics of Nam,73;557-70.1993
15. Usher F.C. Hernai repair with knitted Polypropylene mesh, Surg Gynae Obst 117;239, 1963
16. Browse NL et al Repair of long, large midline Incisional hernia using reflected flaps of anterior rectus sheath reinforced with Marlex mesh, Am J Surg. Nov.138 (:5) 738-9, 1979
17. Durden J.G and Pemberton L.B. Dacron mesh in ventral and Inguinal hernias.
18. Abdul Husn.S. Biomaterials and Herniology, JAMA, 251;1431,1984
19. Ger. R and Dubois E. Prevention and repair of large abdominal wall defects by muscle transposition. Pleural Reconstructive surgery.
20. A comparison of prosthetic materials used to repair abdominal wall defects. Surg. 94;392; 1983
21. Adloff M, and Arnaud J.P, surgical management of large Incisional hernia by

- Intraperitoneal mersilene mesh and an aponeuritic graft. Surg Gynae Obst. 165(3), 204-206, 1987
22. Hamer-Hodges DW, Scott NB. Replacement of abdominal wall defect using expanded PTFE (Gore tex). J.R. CII Surg 1985; 30: 65
 23. Berlimer S.D. Biomaterials and Herniology JAMA, 251;1431, 1982
 24. Jayant sharma. Prolene hernioplasty in Hernia repair. BJS Oct 1997.289-92
 25. Courteny M. Townsend, Daniel Beuchamp, R. Mark Guers, Kenneth L. Mattox, Sabiston Textbook of surgery 18th Edition Vol – 2