**Reviewer #1 response**

1. Don’t have any other photograph.
2. Reference has been updated.
3. Reference links are put in same form.
4. Twenty eight has been written in full text on page 5.
5. In Present study was removed from various places.
6. All patient were followed upto 6 months mentioned on page 11.

**Reviewer #2 response**

1. Inclusion, clinical and imaging criteria are mention in material and method section on page 4.
2. Surgical procedure is described on page briefly on page 5.
3. Chi square test was used for stastical analysis mention on page 5,6,7,8.
4. P value 0.005 was printing mistake it was 0.05, corrected on page 5.

**All correction was mentioned in Red font .**

 **ORIGINAL ARTICLE**

 **Title: A Clinico-Epidemiological Study of Complicated External Hernia**

**Authors**: 1- DR LALIT KISHORE

 2-DR SUMIT NARANIYA

 3-DR DEEPAK VERMA

 4-DR PARUL YADAV

 5-DR AMBRAV VEDPRAKASH

 6-DR RATAN RAJ

**Affiliations:**

 **1**-Assistant professor, Department of Surgery, Dr. Sampurnanand medical college, Jodhpur, Rajasthan

 2-Senior resident, Department of Surgery, Ravindra Nath Tagore medical college, Udaipur , Rajasthan

 3-Senior Professor , Department of Surgery, Dr. Sampurnanand medical college, Jodhpur, Rajasthan

 4-Resident doctor, Department of Surgery, Dr. Sampurnanand medical college, Jodhpur, Rajasthan

5- Resident doctor, Department of Surgery, Dr. Sampurnanand medical college, Jodhpur, Rajasthan

6- Senior resident, Department of Surgery,All India Institute of Medical Sciences, Jodhpur, Rajasthan

**Address of correspondence:**

DR LALIT KISHORE

Assistant Professor, Department of Surgery, Dr. Sampurnanand medical college, Jodhpur, Rajasthan. **drlalitkishore@gmail.com** **9887733389**

**A Clinico-Epidemiological Study of Complicated External Hernia**

**Abstract**

**Background**: Abdominal wall hernias are among the most commonly encountered surgical problem. Irreducibility, obstruction and strangulation are its commonest complications which usually presents as acute emergencies. Emergency repair of complicated hernias is associated with poor prognosis and a high rate of post-operative complications even with better care, improved anaesthetic management and advanced surgical techniques.

 **Methods**: The aim of study was to evaluate incidence, morbidity and mortality in complicated hernia and to compare with it non complicated hernia. This study conducted in Department of General Surgery, Dr. Sampurnanand Medical College, Jodhpur, Rajasthan, from July 2018 to December 2019 on twenty eight patients of complicated hernia and compared with similar no of uncomplicated hernia patients.

**Results:** The mean age of the patients was 52 years with male to female ratio of 11:3 in complicated external hernia group. Majority of the patient (60.7%) underwent herniorrhaphy, followed by hernioplasty (14.3%). Most of the patients (89.2%) survived without any post-operative morbidity, 7.1% of them developing wound sepsis while 3.5% patients died after surgery due to septic shock.

**Conclusion:** Complicated external hernias occur in all age groups but are more common in older age and show preponderance in males. All patients present with irreducible swelling with no cough impulse. The indirect inguinal hernia is the commonest type and herniorrhaphy is the most preferred operative procedure in complicated hernia. Wound sepsis was most common complication. Morbidity and mortality may be attenuated with proper surgical and post- operative management.

**Keywords**: Abdominal wall hernia, Complicated hernia, Herniorrhaphy, Hernia

**INTRODUCTION**

 Abdominal wall hernias are among the most common of all surgical problems. Hernias are relatively innocuous disease in itself and they commonly present as uncomplicated reducible swellings and can be operated in an elective setting with negligible morbidity and mortality1. When they complicate as irreducibility, obstruction and strangulation, and it compels the patient to present as an emergency 2,3, and management of these cases are associated with high morbidity and mortality4 in both developing and developed countries5 A hernia is termed ascomplicated when it becomes irreducible, incarcerated, strangulated or recurrent. Complication becomes grievous when the blood supply of its contents is seriously impaired, rendering gangrene imminent.

 The reason for the hernia to go into complications is because of the hesitancy of the patient to come out with complaints and refusal for surgery in an early stage. The complications make an easily treatable condition into a life threatening one. Early diagnosis and elective repair is a safe and effective strategy for patients of all ages that avoid incarceration, strangulation and their complications6. Although we have made a great progress in treating hernia the management of its complications has progressed only a little. The aim of study was to evaluate incidence, morbidity and mortality in complicated hernia and to compare with it non complicated hernia.

**MATERIAL AND METHODS**

 This observational comparative study was conducted in Department of General Surgery, Dr. S N Medical College, Jodhpur, Rajasthan from July 2018 to December 2019.All patients with groin, epigastric, umbilical/Para-umbilical, lumbar or any type of hernia with age more than 16 years presented with pain with irreducibility, features s/o intestinal obstruction-like Pain abdomen, abdominal distension, vomiting, constipation/obstipation, hypotension, tachycardia shock and features s/o peritonitis were included in study. All patients studied in reference to symptoms, duration of symptoms, type of hernia, management, morbidity and mortality and hospital stay. Patients were divided in Group A (complicated) and Group B (uncomplicated). Patients below age of 16 years and who refused to give consent were excluded from study. All patients were subjected to basic haematological & necessary radiological investigations (USG), chest X-ray, and abdomen X-ray erect view. All symptomatic patients were assessed for emergency surgery and written informed consent was obtained. Under general or spinal anaesthesia, transverse/inguinal/midline incision was made according to clinical presentation. Intra operative finding like site of constriction, contents of sac, viability of contents was noted then contents was reduced, sac is ligated and hernioplasty was performed. If content was gangrenous intestine , Resection and anastomosis was done followed by Herniorapphy (modified bassini repair). Postoperatively managed according to standard protocol. Statistical analysis was performed using Chi square. P value <0.05 was considered statistically significant.

**RESULTS**

 Twenty eight patients were admitted from July 2018 to December 2019 with complicated external hernia and was considered as group A. Total 250 cases of uncomplicated external hernia were admitted from July 2018 to December 2019 out of them 28 patients were randomly selected for study and considered as group B.

**Table 1: Age distribution**

|  |  |
| --- | --- |
| Age ( yrs.) |  Number of patients |
|  | Complicated (Group A) | Uncomplicated(Group B) |
| 16-25 | 01(3.5%) | 00 (0%) |
| 26-35 | 01(3.5%) | 04 (14.3%) |
| 36-45 | 05(17.6%) | 05 (17.6%) |
| 46-55 | 03(10.7%) | 04 (14.3%) |
| 56-65 | 06(21.4%) | 06 (21.4%) |
| 66-75 | 10(35.7%) | 08 (28.6%) |
| 76-85 | 02(7.1%) | 01 (3.5%) |
| Total | 28 (100%) | 28 (100%) |

chi sq 3.498,df 6,p val 0.744

 Complicated external hernias were observed in between 66 to 75 years (35.7%). Although complication was reported in as young as 22 years to 85 years with mean age of 52 years. In group B, patients were in the age range of 26-85 years with mean age of 55 years,but here also majority of patients (28.6%) belonged to 66-75 years age group. On applying Chi square test , P value was 0.744 , statistically not significant.(chi sq 3.498,df 6, P Value 0.744).

 **Table 2: Distribution of type of hernia**

|  |  |  |  |
| --- | --- | --- | --- |
| Site of Hernia |  Complicated( A) | Uncomplicated( B) | P value |
| Epigastric | 05 (17.9%) | 04 (14.2%) | 0.716(NS) |
| Inguinal | Right | Direct | 00 (0%) | 04 (14.2%) | 0.077(NS) |
| Indirect | 09 (32.1%) | 10 (35.7%) |
| Left | Direct | 00 (0%) | 03 (10.7%) | 0.017(S) |
| Indirect | 07 (25%) | 02 (7.1%) |
| Umbilical | 03 (10.7%) | 02 (7.1%) | 0.639(NS) |
| Para-umbilical | 04 (14.3%) | 03 (7.1%) | 0.686(NS) |
|  Total | 28 (100%) | 28 (100%) |  |

 In our study majority of patients (57.1% complicated ,67.8% uncomplicated) were found to be having inguinal hernia. Among them right sided direct inguinal hernias and left side indirect were predominant . All the other forms of hernia except inguinal were observed to be more associated with complications viz , Epigastric (17.9%), para-umbilical (14.3%) & umbilical hernias (10.7%) were observed as complicated hernia though statistically no significant difference found to be there between complicated and uncomplicated forms.

 **Table 3 : Operative procedure performed**

|  |  |  |
| --- | --- | --- |
| Operative procedure | Complicated hernia (A) | Uncomplicated hernia(B) |
| Herniorrhaphy | 17 (60.7%) | 02 (7.1%) |
| Exploratory laparotomy & repair | 04 (14.3%) | 00 (0%) |
| Exploratory laparotomy with resection & end to end anastomosis with herniorrhaphy | 03 (10.7%) | 00 (0%) |
| Mesh Hernioplasty | 04 (14.3%) | 26 (92.9%) |

 chi square 34.98,df 3, p value <0.0001(S)

 Most patients of complicated hernia underwent herniorrhaphy(60.7%), followed by hernioplasty (14.3%), exploratory laparotomy with repair (14.3%), & resection of gangrenous segment with end to end anastomosis with herniorrhaphy (10.7%).While most of the patients with uncomplicated hernia underwent mesh hernioplasty and this difference between both group of hernias was found to be statistically significant(chi square 34.98,df 3, p value <0.0001)

 **Table 4: Post-operative complications**

|  |  |
| --- | --- |
| Post operative Complication | Number of patients |
| Complicated(A) | Uncomplicated(B) |
| No complication | 25 (89.3%) | 28 (100%) |
| Wound sepsis | 02 (07.1%) | 00 (0%) |
| Shock | 01 (3.5%) | 00 (0%) |

 Most of patients of complicated hernia (89.3%) survived without any post-operative morbidity, while only 7.1% of them developing wound sepsis, & 3.5% patients developed post-operative shock. 3.5% patients expired after surgery due to septic shock.

 **Table 5 : Hospital stay**

|  |  |  |
| --- | --- | --- |
| Duration of stay ( days) | Complicated (A) | Uncomplicated(B) |
| 1 to 3 | 02 (7.1%) | 00 (0%) |
| 4 to 7 | 14 (50%) | 26 (92.9%) |
| 8 to 10 | 09 (32.1%) | 02 (7.1%) |
| 11 to 15 | 01 (3.5%) | 00 (0%) |
| >15 | 02 (7.1%) | 00 (0%) |

##  Chi square 13.05,df 4,p value 0.010(S)

##  Most operated patients of complicated hernia (50%) spent 4 to 7 days in hospital, while 7.1% patients required hospital stay for more than 15 days, and another 7.1% patients required 1-3 days of stay. In case of uncomplicated hernia group , majority of patients(92.9%) had similar duration hospital stay i.e.4-7 days.

## DISCUSSION

 The external abdominal wall hernia is most commonly encountered in surgical practices. When they presented as complicated hernia, prognosis is poor even after standard protocol management. In present study, complicated external hernias were observed in between 66 to 75 years (35.7%). Although complication was reported in as young as 22 years to 85 years with mean age of 52 years. In group B, patients were in the age range of 26-85 years with mean age of 55 years. Kulah7 observed the mean age for complicated external hernia was 55 years, with 42.9% of patients aged more than 60 years. Alavarez8  also observed that 66.7% of cases were more than 65 years of age. Hence, it is evident from the present study the incidence in complications increases with advancing age. In present study, the incidence of complicated external hernia was more in male (78.6%), with male to female ratio of 11:3, indicating high incidence of complicated external hernia among male patients. Similar male predominance was observed in other studies by Kulah7 (65%), Alvarez8 (52.4%), Hariprasad9 (95%) and Prakash10 (94.3%). In present study, 57.1% patients had indirect inguinal hernias. Among them right sided indirect inguinal hernias were predominant (32.1%). Epigastric (17.9%), para-umbilical (14.3%) & umbilical hernias (10.7%) were also observed as complicated hernia.

 In present study, 64.3% patients had irreducible hernia 28.9% had obstructed hernia and 7.1% had strangulated hernia depicted in figure 1. Hariprasad9 observed incarceration in 70% of cases, and strangulation in 30% cases. Prakash10 observed 23% patients of irreducible hernia, 63% of obstructed hernia and 14% of strangulated hernia. Kappikeri11 observed 44% cases of irreducible hernia, 36% of obstructed hernia and 20% cases of strangulated hernia. Kulah7 observed 41.6% patients with irreducible hernia, 19.7% with obstructed hernia and 38.7% with strangulated hernia.

 In our study57.1% patients had indirect complicated inguinal hernia where deep ring was the commonest site for constriction of the hernia, followed by epigastric 17.9%, para-umbilical 14.3% & umbilical hernia 10.7%. Rectus sheath was the commonest site of obstruction in epigastric, umbilical and paraumblical hernia. Similarly, Prakash10reported deep ring as the commonest site of constriction (71.4%) in groin hernia. Hariprasad9also concluded that the site of obstruction in most patients was seen at deep inguinal ring (92.5%), whereas in case of direct inguinal hernia obstruction was at the neck of the sac.

 Omentum alone was the commonest content of the complicated hernial sac (46.4%), followed by omentum with bowel loop (32.1%),small bowel only (10.7%), colon only ( 10.7%) & omentum with colon (14.3%). Hariprasad9found only omentum as the viable content in most (32.5%) cases, followed by omentum and small bowel 30% cases, small bowel alone and sigmoid colon one case each, and large bowel with omentum in 10% cases. Andrew12 reported the small bowel as the commonest content of incarcerated inguinal hernia; followed by omentum. In Kulah7’sstudy also, contents of hernial sac were only ileum in 39.7% patients, only omentum in 27.1% patients, ileum with omentum in 10.9% patients, & only colon in 28.5% patients. Alvarez8found only omentum as the content of the hernial sac in 37.4% patients, only ileum in 27.2% patients, ileum with omentum in 10.8%, only colon in 4.1%, colon with omentum in 1.4%. Prakash10found small bowel as commonest content (74.3%) followed by omentum (25.7%). Kappikeri11observed small intestine to be the commonest content of the hernia sac (54%), followed by omentum (18%).In control group, most of the patients (92.9%) had omentum as the content of the hernial sac, followed by pre-peritoneal fat in epigastric hernia (7.1%).

 In present study**,** only 7.1% had gangrenous content, rest of the patients (92.9%) had viable content depicted in figure 2. Kappikeri11observed the non viable content in 12% of patients. Alvarez8observed that 12.9% patients had gangrenous content in the sac. Hariprasad9also observed the non- viable bowel content in 22.5% cases. In control group, all patients (100%) had viable content in their sacs.

 Most of patients ( 60.7%) underwent herniorrhaphy, followed by hernioplasty (14.3%), exploratory laparotomy with repair (14.3%), & resection of gangrenous segment with end to end anastomosis with herniorrhaphy (10.7%) shown in Table 3. Hariprasad9’observed that, herniorraphy was done in all cases (100%) for closure, & modified Bassini's repair was performed in inguinal hernias. Laparotomy & repair was done in 25% cases. Prakash10also reported that the optimum procedure for hernia repair was herniorrhaphy which was done in 82.8% cases whereas herniorrhaphy along with resection anastomosis was done in 8.6% cases and herniorrhaphy along with repair was done in 8.6% cases. Kappikeri11 concluded that herniorrhaphy was the commonest (74%) surgical procedure performed for complicated inguinal hernias, while 14% patients underwent hernioplasty, 12% patients of strangulation with non-viable bowel required resection and anastomosis followed by herniorrhaphy. In control group, most patients (92.9%) underwent mesh hernioplasty, while 7.1% underwent herniorrhaphy.

 In our study 89.2% survived without any post-operative morbidity, while only 7.1% of them developing wound sepsis & 3.5% patients died after surgery due to septic shock depicted in Table 4.

Haapaniemi13observed that 5.5% cases died, 3% of them due to associated medical illness & 2.5% from septicemia. He found that mortality increase in emergency repair of hernia and in patients who had bowel resection. Hariprasad9 also observed that the common postoperative complication was wound infection (22.5%) and scrotal seroma (17.5%) followed by scrotal hematoma (7.5%). Septicemia, multi- organ failure and death occurred in 2.5% cases. Prakash10observed wound infection as complication in 11.5% patients. Kappikeri11observed 6% mortality among the cases, 2% patients due to ischemic heart disease, while 4% cases expired following bowel resection in strangulated hernia. In Group B, none of the patients (0%) had encountered with any post-operative complication and all patients (100%) survived after surgery

##  The duration of most operated patients (50%) was 4 to 7 days in hospital, while 7.1% patients required hospital stay for more than 15 days, and another 7.1% patients required 1-3 days of stay shown in Table 5. In Kappikeri11’s study most of the patients (46%) were discharged within 11-15 days. In control group, most patients (92.9%) spent 4 to 7 days in hospital, with 7.1% patients required between 8 to 10 days of stay. All patient were followed up to 6 months, however no complications were noted.

**CONCLUSION**

 Complicated external hernias occur in all age groups but are more common in older age and show preponderance in males. All patients present with irreducible swelling with no cough impulse. The indirect inguinal hernia is the commonest type and right sided inguinal hernia predominated as compared with left. Herniorrhaphy was the most preferred operative procedure in complicated hernia. Morbidity and mortality may be attenuated with proper surgical and post- operative management.

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 **Ethical committee approval was obtained prior to study**.

 **Conflict of interest**: All authors agree that there were no conflicts of interest.

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 **Figure 1: Preoperative picture showing obstructed inguinal hernia.**

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**Figure 2: Intra-operative photo showing viable colon and omentum as content of sac.**