

(RESEARCH ARTICLE)



A study of clinical profile and management of Umbilical hernia in tertiary care unit: An observational study

Jaiswal N, Chavan K*, Nande Y and Agrawal A

Department of General Surgery, Indira Gandhi Government Medical College and Hospital, Nagpur.

International Journal of Frontiers in Medicine and Surgery Research, 2026, 08(01), 027-036

Publication history: Received on 17 May 2026; revised on 24 June 2026; accepted on 26 June 2026

Article DOI: <https://doi.org/10.53294/ijfmsr.2026.8.1.0022>

Abstract

Background: Umbilical hernia is a common abdominal wall defect in adults and is frequently associated with obesity, multiparity, and conditions causing increased intra-abdominal pressure. Despite its prevalence, optimal management strategies continue to be debated. This study evaluated the clinical profile, predisposing factors, surgical management, and postoperative outcomes of adult patients with umbilical hernia treated at a tertiary care centre.

Methods: A prospective observational study was conducted in the Department of General Surgery of a tertiary care teaching hospital over 18 months. Sixty adult patients diagnosed with umbilical hernia and undergoing surgical treatment were enrolled using consecutive sampling. Demographic characteristics, risk factors, clinical presentation, operative details, postoperative complications, hospital stay, and recurrence were recorded using a standardized proforma. Data were analysed using SPSS version 22. Descriptive statistics were expressed as frequencies, percentages, and mean $\pm$ standard deviation.

Results: The majority of patients were aged 41–50 years (26.7%), with a female predominance (60%). Obesity (41.7%) and multiparity (33.3%) were the most common predisposing factors. Most hernias were reducible (66.7%), and 50% had defect sizes ranging from 2–4 cm. Open repair was performed in 75% of patients, while mesh reinforcement was used in 80%. Postoperative recovery was uneventful in 73.3% of cases. Seroma formation (10%), surgical site infection (8.3%), hematoma (5%), and mesh infection (3.3%) were the most common complications. Most patients were discharged within 3–6 days. Recurrence was observed in only 5% of patients during follow-up.

Conclusion: Adult umbilical hernia predominantly affects middle-aged women and is strongly associated with obesity and multiparity. Open mesh repair remains the preferred surgical approach and is associated with low complication and recurrence rates, supporting its safety and effectiveness in tertiary care settings.

Keywords: Umbilical Hernia; Mesh Repair; Obesity; Surgical Outcomes; Recurrence; Adult Hernia

1. Introduction

Sir Astley Paston Cooper had once remarked, very well that, “No disease of the human body belonging to the province of the Surgeon requires in its treatment a better combination of accurate anatomical knowledge with surgical skill than Hernia in all its varieties” (1). Hernia, that is characterised by an abnormal protrusion of the abdominal contents originates from Greek word for “bulge”. It is also represented by the Latin terminology for “rupture,” thereby representing the bursting out of the intra-abdominal contents through an abdominal wall defect (2). A distinguished subset of the abdominal wall hernias is formed by the umbilical hernias. They could be congenital, occurring as a result

* Corresponding author: Chavan K

of the incomplete umbilical ring closure or may even be acquired later in life. The acquired umbilical hernias are more often than not associated with factors such as obesity, multiparity, or even with liver cirrhosis (3).

The hernias of the abdomen are a common surgical problem with a prevalence of roughly 1.7% among the general population, which may rise up to 4% in individuals who are above 45 years of age (4). Globally, there are >20 million surgeries for hernia repairs annually. This underscores the clinical as well as socioeconomic burden attributable to the disease (5). Umbilical hernias comprise of nearly 6–14% of all the abdominal wall hernias among adults, with >90% of them being acquired type (6). Paraumbilical hernias are closely related with umbilical defects. Their prevalence rises steeply after the age of 35 years and are as high as five times more common among women, and is often associated with underlying structural weaknesses of the linea alba and the umbilical fascia (7).

Despite the high prevalence of umbilical hernias in adults, their pathogenesis remains debatable. Congenital defects are generally well defined; however, the acquired hernias develop following the progressive abdominal wall musculature weakening rather than being present since childhood (8). If surgical treatment is not sought, there is a very high risk of the development of complications like incarceration or even strangulation. There are no universal guidelines or consensus statements on the optimally used technique for its repair (9). This presents a research gap due to the lack of standardised protocols for the management of umbilical hernias.

The study aimed to evaluate the clinical profile, predisposing factors, surgical management, and postoperative outcomes of adult patients presenting with umbilical hernia in a tertiary care centre.

Objectives

The objectives of the study were

To analyse the clinical profile of patients with an umbilical hernia. To identify the predisposing factors of the umbilical hernia. To find out the recurrence rate. To study various surgical treatment options and their outcomes.

2. Material and Methods

2.1. Study Design

The present study was a prospective observational study conducted to evaluate the clinical profile, risk factors, operative management, postoperative complications, and outcomes of adult umbilical hernia patients undergoing surgical treatment at a tertiary care teaching hospital.

2.2. Study setting

The study was conducted in the Department of General Surgery at Tertiary Care Hospital after obtaining approval from the Institutional Ethics Committee.

2.3. Study Duration

The study was conducted over a period of 18 months

2.4. Study Population

The study population consisted of all adult patients presenting to the Department of General Surgery with a diagnosis of umbilical hernia during the study period.

2.5. Sample Size

A total of 60 patients diagnosed with adult umbilical hernia and fulfilling the inclusion and exclusion criteria were included in the study.

2.6. Sampling Technique

Consecutive sampling was employed. All eligible patients presenting during the study period were included until the desired sample size was achieved.

2.7. Inclusion Criteria

- Adult patients aged 18 years and above.
- Patients clinically diagnosed with umbilical hernia.
- Both elective and emergency cases.
- Patients willing to participate in the study and provide informed consent.

2.8. Exclusion Criteria

- Pregnant women.
- Patients with paraumbilical, epigastric, Spigelian, or incisional hernias.
- Patients requiring surgery for major concomitant abdominal pathology.
- Patients unwilling to participate.
- Patients unfit for surgery.
- Patients lost to follow-up.

2.9. Ethical Considerations

Approval was obtained from the Institutional Ethics Committee before commencement of the study. All the study participants provided the “written informed consent”.

2.10. Study Procedure

A standardized case record form was utilized to obtain the history, record the clinical examination findings, laboratory investigation, operative findings and the postoperative outcomes.

2.11. Statistical Analysis

The data obtained was entered in Microsoft Excel and Statistical Package for Social Sciences (SPSS) version 22 was used for the analysis. Expression of the categorical variables was done using frequency and percentage. Whereas, continuous variables were denoted by mean $\pm$ standard deviation. The Chi-square test and the student's t-test were used to study the associations and comparisons where appropriate. A p-value of <0.05 was considered statistically significant.

3. Results

The study recruited 60 patients who were diagnosed with an umbilical hernia. The data on the demographic profile of the cases, their body mass index (BMI), socioeconomic status, clinical features like the defect size, and predisposing factors for the development of umbilical hernia were analysed in order to understand the epidemiology, clinical characteristics and predisposing factors among the study population.

Table 1 Baseline characteristics of study participants (n=36)

Characteristics	Number	Percentage
Age (in years)		
18-30	8	13.3%
31-40	12	20%
41-50	16	26.7%
51-60	14	23.3%
>60	10	16.7%
Gender		
Male	24	40%
Female	36	60%
BMI categories		
Normal	15	25%

Overweight	20	33.3%
Obese	25	41.7%
Socio-economic status		
Upper	1	2.78
Upper middle	4	11.11
Lower middle	13	36.11
Upper Lower	14	38.89
Lower	4	11.11

Table 1 depicts the baseline characteristics of the study participants. The majority of the patients were in the age group of 41–50 years (26.7%), which was followed by 51–60 years (23.3%) and 31–40 years (20.0%). Patients with age >60 years constituted about 16.7% of the study population, while the younger age group (18–30 years) comprised of 13.3% of the participants.

Among the cases, females (60%) were predominant as compared to males (40%). The commonest BMI category was obesity, which was observed among 41.7% of patients. Overweight individuals included in the study were 33.3%. Only 25% of the participants displayed normal BMI. Most of the patients were from the upper-lower (38.89%) class and 36.11% from the lower-middle socioeconomic class, whereas only a few patients belonged to the upper socioeconomic class (2.78%).

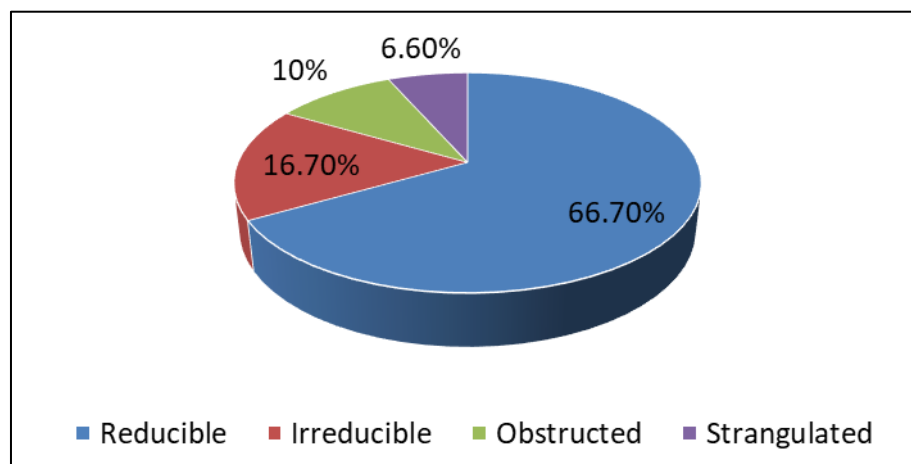


Figure 1 Distribution of umbilical hernia according to clinical type (n=60)

Figure 1 shows the distribution of the clinical features observed among the patients of umbilical hernia. Majority of the cases were diagnosed with reducible hernias (66.7%), followed by irreducible hernias among 16.7%. Obstructed hernias were seen in 10.0%, while strangulated hernias were seen in the smallest proportion of 6.6% of the study participants.

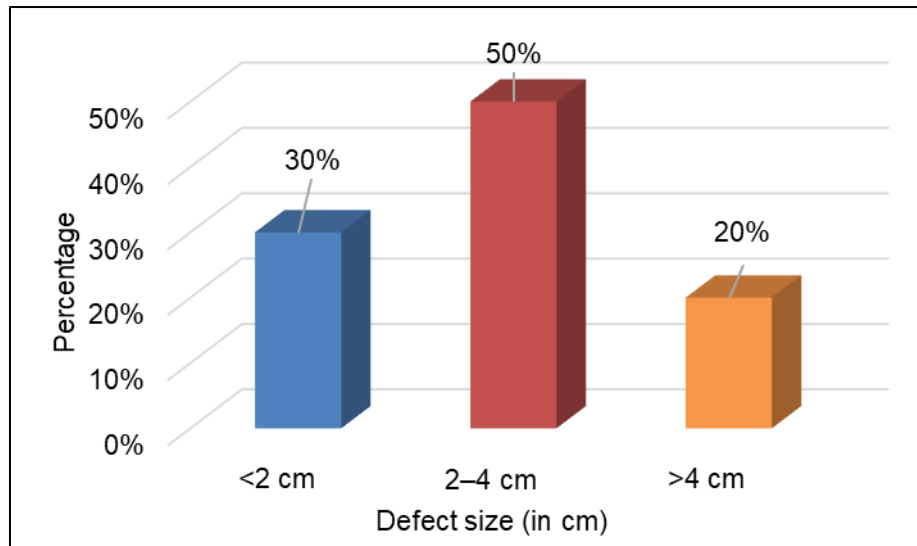


Figure 2 Distribution according to the size of the defect (n=60)

Figure 2 shows the distribution of the patients according to the defect size. Commonest defect size observed was 2–4 cm, in 50.0% of the cases. Whereas, defects that measured <2 cm were present in 30.0%, whereas only 20.0% of the patients had defects that measured > 4 cm.

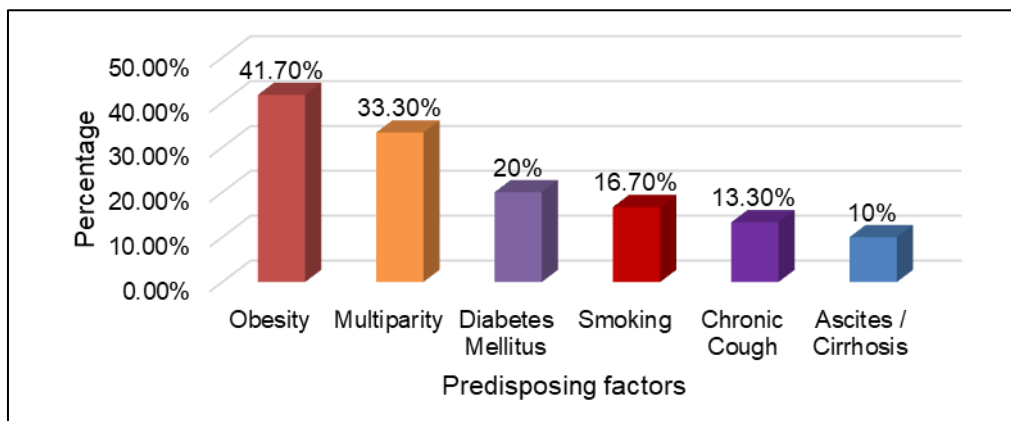


Figure 3 Distribution of cases according to the predisposing factors (n=60)

The predisposing factors for umbilical hernia are shown in Figure 3. The commonest observed risk factor was obesity in 41.7%, followed by multiparity among 33.3%. Other risk factors were diabetes mellitus (20.0%), smoking (16.7%), chronic cough (13.3%), and ascites/cirrhosis (10.0%).

Open repair was the commonest approach (75%) among several surgical approaches. Whereas laparoscopic repair was adopted in 25% of the cases. This fact is a testament to the use of open repair still being the preferred technique in low-resource settings. This could be due to factors like surgeon preference, resource constraints, and the characteristics of the hernial defect.

The predominantly adopted method of repair was mesh repair, which was performed in nearly 80% of patients. while primary repair using sutures was carried out in approximately 20% of the cases. This shows the rising demand and preference for the preference of prosthetic mesh for the surgical management of umbilical hernia. This could be due to the fact that mesh repair is highly effective in reducing the rate of recurrence.

Table 2 Surgical outcomes (n=60)

Complication	Number	Percentage
Seroma	3	10%
Hematoma	1	5%
Surgical Site Infection	2	8.3%
Mesh Infection	2	3.3%
No Complications	52	73.3%
Total	60	100%

The postoperative course was uneventful in the majority of the participants (73.3%). This indicates favourable surgical outcomes that might have been due to effective perioperative management. Among the commonly observed complications, seroma formation was seen in 10%, followed by surgical site infections among 8.3%, while hematoma was seen in 5% of the cases, and mesh infection was present in 3.3%. These findings were suggestive of the fact that umbilical hernia surgery is safe, with a very low incidence of postoperative complications that can be managed with use of appropriate treatment.

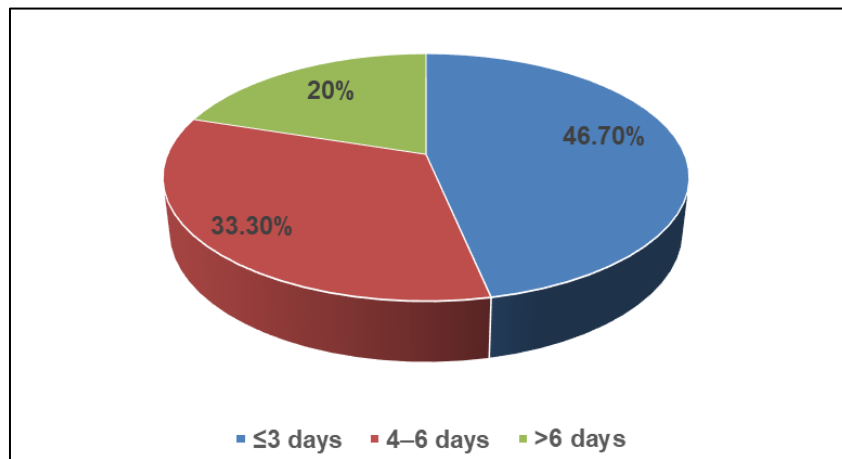
**Figure 4** Distribution according to the duration of hospitalisation (n=60)

Figure 4 shows the duration of hospital stay of the patients. It was observed that 46.7% of the cases had a hospital stay for three days or less, while nearly a third of them remained hospitalised for a duration of 4–6 days. Only a smaller proportion (20%) required hospitalisation for >6 days. The mean hospital stay was approximately 4–5 days, suggesting that most of the patients experienced an uneventful postoperative recovery.

There was a very low recurrence rate observed among 3 (5%) of the cases, while 57 (95%) of them did not show any recurrence during their follow-up. The low recurrence rate is indicative of the favourable surgical outcome using the appropriate treatment modalities.

4. Discussion

The present study aimed to evaluate the clinical profile as well as the management and treatment outcomes of patients who underwent surgical treatment for umbilical hernia. The findings about the socio-demographic characteristics, predisposing factors, clinical presentation, and surgical as well as postoperative outcomes are very insightful. Overall, the present study demonstrates that umbilical hernia predominantly affects the middle-aged populations, particularly women, those with obesity and other conditions that increase the intra-abdominal pressure. Surgical management, predominantly through open mesh repair, resulted in favourable postoperative outcomes with low complication and recurrence rates.

In the present study, the highest proportion of patients belonged to the 41–50-year age group (26.7%), followed by the 51–60-year age group (23.3%). The findings indicate that umbilical hernia was more frequently observed among middle-aged and older adults, with a predominance among females. The high proportion of overweight and obese patients suggests that increased intra-abdominal pressure associated with excess body weight may play an important role in the development of umbilical hernia. Furthermore, the concentration of cases in lower and lower-middle socioeconomic groups may reflect differences in healthcare access, occupational factors, nutritional status, or delayed healthcare-seeking behaviour.

These findings are consistent with contemporary literature indicating that adult umbilical hernias are most frequently diagnosed during middle and later adulthood, when age-related weakening of the abdominal wall combines with chronic exposure to factors that increase intra-abdominal pressure. Henriksen et al. reported a similar age distribution among patients undergoing elective repair, with the majority of cases occurring after the fourth decade of life (10). The predominance of middle-aged patients in the current study may therefore reflect the cumulative effects of obesity, pregnancy, chronic respiratory conditions, and connective tissue degeneration over time.

Female patients constituted 60% of the study population. This observation agrees with reports from several clinical series that have documented a higher prevalence of umbilical hernia among women, particularly those with a history of multiple pregnancies (11). Pregnancy-related stretching of the abdominal wall, hormonal influences on connective tissue integrity, and repeated increases in intra-abdominal pressure are recognised mechanisms contributing to hernia formation. The relatively high prevalence of multiparity (33.3%) among our patients further supports this explanation. However, some Western studies have reported a male predominance, especially in populations with higher rates of occupational heavy lifting and obesity (12). Such differences may be attributable to variations in population demographics, lifestyle factors, and referral patterns between regions.

Obesity emerged as the most important predisposing factor in the present study, affecting 41.7% of patients, while an additional 33.3% were overweight. The predominance of obesity and multiparity suggests that conditions associated with increased intra-abdominal pressure play a major role in the pathogenesis of umbilical hernia. Co-morbidities like hypertension, diabetes mellitus and habits like smoking further impair healing of the connective tissues and also weaken them further. Chronic conditions like cough and cirrhosis or ascites, are considered as the risk factors contributing to the development of hernia through persistently elevated intra-abdominal pressure. The findings from the present study thus emphasise the urgent need for addressing these modifiable risk factors and focus on them as a part of the comprehensive patient management for abdominal wall hernias. This approach will also aid in reducing the postoperative complications as well as the recurrence rate.

Recent studies on ventral as well as umbilical hernia have reported similar findings wherein high BMI was the major contributor to the development of hernia, as well as for higher rate of postoperative complications, and higher recurrence rates (13). Adiposity leads to increased intra-abdominal pressure, which poses a continued stress on the umbilical ring as well as the surrounding fascia, thereby leading to hernia formation. Additionally, obesity complicates wound healing and also alters collagen metabolism, thereby negatively influencing the surgical outcomes. The current study, therefore, emphasises the important role of weight optimisation for preoperative patient preparation.

Most patients belonged to lower-middle and upper-lower socioeconomic classes. Although the effect of socioeconomic status has seldom been evaluated in hernia literature, these factors may corroborate with the features like delayed healthcare access, poor nutrition, engaging in physically demanding occupations, and above all the factors, there might be limited awareness about the disease as well as the treatment modalities, which may contribute to disease progression before its presentation to the healthcare facility. Similar findings from low- and middle-income countries reflect similar trends, in which patients frequently present with larger defects or complicated hernias due to delayed medical consultation (14).

Reducible hernias were observed among 66.7% of the cases, whereas irreducible, or obstructed, and strangulated hernias were seen in nearly one-third of the participants. This pattern was comparable to that observed in several surgical studies, in which the majority of patients had uncomplicated and reducible hernias (10). The relatively lower proportion of obstructed or strangulated hernias (6.6%) may strongly indicate the possibility of timely referral as well as heightened awareness about the necessity for elective surgery in cases with uncomplicated hernias. Nevertheless, those with complicated hernias are at increased risk due to delay in receiving appropriate intervention.

Medium-sized defects ranging from 2–4 cm were the commonest presentation. This is clinically relevant as the defect size has a bearing on the choice of surgical technique and whether or not a mesh reinforcement will be needed. On the other hand, the larger defects measuring >4 cm, though rare can cause greater operative complexity and are at a greater

risk of recurrence. These findings were found to be congruent with certain recommendations given by the “European Hernia Society” and the “American Hernia Society”. They classify primary umbilical hernias measuring >1 cm as in need for mesh reinforcement in order to reduce the recurrence rates (11). There is a strong direct relationship of the defect size with recurrence. Larger defects are prone for increased operative complexity and have a greater likelihood of recurrence after tissue repair alone without mesh reinforcement (15).

Open repair was performed in 75% of patients, whereas laparoscopic repair was undertaken in 25%. The predominance of open surgery observed in the present study reflects prevailing practice patterns in many tertiary care institutions, particularly in resource-constrained settings. Open repair remains a reliable and cost-effective technique with well-established outcomes. Although laparoscopic repair offers advantages such as reduced wound morbidity and shorter recovery in selected patients, its utilisation may be influenced by surgeon expertise, equipment availability, and hernia characteristics (11). The preference for open repair in this study is therefore understandable and consistent with routine surgical practice in many developing regions.

Mesh repair was performed in 80% of cases, highlighting the growing acceptance of prosthetic reinforcement in umbilical hernia surgery. This finding is supported by current evidence demonstrating superior outcomes with mesh compared with primary suture repair. A nationwide database study by Henriksen et al. and a systematic review by Bisgaard and colleagues reported significantly lower recurrence rates following mesh repair, even for relatively small umbilical defects.^{10,16} Consequently, current international guidelines recommend mesh reinforcement for most adult umbilical hernias to minimise recurrence risk.¹¹ The high utilisation of mesh in the present study likely contributed to the favourable postoperative outcomes observed.

Postoperative complications were relatively uncommon, with 73.3% of patients experiencing no adverse events. Seroma formation was the most frequent complication (10%), followed by surgical site infection (8.3%), hematoma (5%), and mesh infection (3.3%). Comparable complication rates have been reported in recent literature evaluating open mesh repair, where seroma and superficial wound infection remain the most frequently encountered postoperative events.¹⁷ Importantly, most complications in the current study were manageable and did not significantly affect overall recovery. The low incidence of mesh infection further supports the safety of mesh utilisation when appropriate operative technique and perioperative infection-control measures are employed.

The average hospital stay was within three days for the majority of the participants. The mean stay is of approximately four to five days. This finding is suggestive of satisfactory postoperative recovery as well as effective perioperative care. Similar durations of hospitalisation have been reported following elective umbilical hernia repair in both open and laparoscopic series (12). Shorter hospital stays are increasingly achievable due to advances in anaesthesia, pain management, and enhanced recovery protocols.

Low recurrence rate of 5% was particularly encouraging and compared favourably with the rates reported in the literature, ranging from 2% to 27%. The factors determining the recurrence were defect size, patient characteristics, and the repair technique used (18). Mesh repair was utilised widely, but needed careful patient selection and surgical expertise. This may partially explain the favourable recurrence outcomes observed. Furthermore, known risk factors for recurrence, including obesity, diabetes, smoking, and larger defects, were recognised and addressed during management, potentially contributing to improved long-term results (18, 19).

The findings were consistent with the contemporary evidence related to the epidemiology and management of umbilical hernia. Higher incidence among middle-aged females, association with obesity and multiparity, the preference for mesh repair, and the low complication rates, as well as lower recurrence, all are in favour of early elective surgical repair with the use of prosthetic mesh reinforcement. Continuing the emphasis on the reduction of risk factors, particularly weight reduction along with the control of comorbidities, has the potential to improve surgical outcomes and also minimise recurrence.

5. Conclusion

Umbilical hernia mostly affects middle-aged adults, specifically females. Obesity as well as multiparity were the most commonly observed predisposing factors. Most patients had reducible hernias with medium-sized defects. The popular surgical approach was open mesh repair that showed favourable outcomes, in terms of a low postoperative complications rate, shorter duration of hospital stay, and a very low recurrence rate. Contemporary surgical treatment is an effective and safe management modality for umbilical hernia in tertiary care settings.

Recommendations

Early diagnosis, coupled with elective surgical repair using mesh, should be encouraged to prevent the progression to complicated hernias. Optimisation of the modifiable predisposing factors, such as obesity, diabetes, smoking, and chronic respiratory conditions, should be included in routine management. Mesh reinforcement in appropriate patients can reduce the risk of recurrence and improve the long-term outcomes.

Limitations

Being a single-centre study with a relatively small sample, limits the generalizability of the findings. The observational design precludes any causal inferences, and the duration of follow-up may be insufficient to decipher late recurrences as well as the long-term complications.

Implications for Future Research

Large multicentric prospective cohort studies with a longer duration of follow-up are needed to validate the findings in diverse populations. Future research should be focused on the comparison of the open and the laparoscopic approaches, along with the evaluation of the patient-reported outcomes, including quality of life. The impact of preoperative risk-factor modification can be evaluated on the postoperative outcomes and the recurrence rates.

Key Messages

- Umbilical hernia was most commonly observed in middle-aged women and was strongly associated with obesity and multiparity.
- Reducible hernias and defects measuring 2–4 cm constituted the majority of presentations.
- Open mesh repair was the predominant treatment modality and produced favourable outcomes.
- Postoperative complications were infrequent and largely manageable.
- The recurrence rate was low, supporting the effectiveness of mesh-based repair in appropriately selected patients.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

- [1] Cooper AP. Lectures on the Principles and Practice of Surgery. London: Burgess and Hill; 1824.
- [2] Kingsnorth AN, LeBlanc KA. Management of abdominal wall hernias. 3rd ed. London: Springer; 2013.
- [3] Asolati M, Huerta S, Sarosi G, et al. Predictors of recurrence in veteran patients with umbilical hernia. *Am J Surg*. 2006;192(5):627–630.
- [4] Luijendijk RW, Hop WC, van den Tol MP, et al. A comparison of suture repair with mesh repair for incisional hernia. *N Engl J Med*. 2000;343(6):392–398.
- [5] Kingsnorth AN, Majid A, Shute K. Prospective randomized trial of laparoscopic versus open repair of incisional hernia. *Br J Surg*. 2006;93(10):1181–1185.
- [6] Arroyo A, García P, Pérez F, et al. Randomized clinical trial comparing suture and mesh repair of umbilical hernia in adults. *Br J Surg*. 2001;88(10):1321–1323.
- [7] Muschaweck U, Berger D. Minimal repair technique of paraumbilical hernia in adults. *World J Surg*. 2003;27(4):458–461.
- [8] Henriksen NA, Montgomery A, Kaufmann R, et al. Recurrence after umbilical hernia repair: a registry-based study. *Surgery*. 2013;153(3):396–403.

- [9] Bikhchandani J, Fitzgibbons RJ Jr. Repair of umbilical hernia. *Surg Clin North Am.* 2008;88(1):45–60.
- [10] Henriksen NA, Jensen KK, Bisgaard T, Helgstrand F, Danish Hernia Database Group, et al. Suture or mesh repair of the smallest umbilical hernias: a nationwide database study. *World J Surg.* 2022;46(8):1898-1905. doi:10.1007/s00268-022-06520-1. Available from: <https://doi.org/10.1007/s00268-022-06520-1>
- [11] Henriksen NA, Montgomery A, Kaufmann R, Berrevoet F, East B, Fischer J, et al. Guidelines for treatment of umbilical and epigastric hernias from the European Hernia Society and Americas Hernia Society. *Br J Surg.* 2020;107(3):171-190. doi:10.1002/bjs.11489. Available from: <https://doi.org/10.1002/bjs.11489>
- [12] Howard R, Greenberg J, Telem D, Morris M, Prabhu A, Liang M, et al. Mesh overlap for ventral hernia repair in current practice. *Surg Endosc.* 2023;37(12):9308-9316. doi:10.1007/s00464-023-10339-8.
- [13] Liu JK, Purdy AC, Moazzez A, La Riva A, Ozao-Choy J, Smith BR, et al. Defining a body mass index threshold for preventing recurrence in ventral hernia repairs. *Am Surg.* 2022;88(10):2465-2471. doi:10.1177/00031348221102608. Available from: <https://doi.org/10.1177/00031348221102608>
- [14] Köckerling F, Simon T, Hukauf M, Hellinger A, Fortelny R, Reinpold W, et al. The importance of registries in abdominal wall hernia surgery. *Hernia.* 2021;25(3):617-626. doi:10.1007/s10029-020-02327-8.
- [15] Tao Z, Ordonez J, Huerta S. Hernia size and mesh placement in primary umbilical hernia repair. *Am Surg.* 2021;87(6):945-951. doi:10.1177/0003134820971624. Available from: <https://doi.org/10.1177/0003134820971624>
- [16] Bisgaard T, Kaufmann R, Christoffersen MW, Strandfelt P, Gluud LL, Jorgensen LN, et al. Lower risk of recurrence after mesh repair versus non-mesh sutured repair in open umbilical hernia repair: a systematic review and meta-analysis of randomized controlled trials. *Scand J Surg.* 2019;108(3):187-193. doi:10.1177/1457496918812208. Available from: <https://doi.org/10.1177/1457496918812208>
- [17] Deerenberg EB, Henriksen NA, Jairam AP, Kaufmann R, Berrevoet F, East B, et al. Contemporary outcomes after elective ventral and umbilical hernia repair: a review of postoperative morbidity. *Hernia.* 2022;26(4):891-901. doi:10.1007/s10029-021-02527-4.
- [18] Mannion J, Hamed MK, Negi R, Johnston A, Bucholc M, Sugrue M, et al. Umbilical hernia repair and recurrence: need for a clinical trial? *BMC Surg.* 2021;21:365. doi:10.1186/s12893-021-01358-1. Available from: <https://doi.org/10.1186/s12893-021-01358-1>
- [19] Popescu RC, Georgescu SO, Pantea S, Florescu IP, Mogoanta SS, Serban D, et al. Preoperative risk factors in hernia recurrence: a single-center study. *J Mind Med Sci.* 2024;11(1):146-155. doi:10.22543/2392-7674.1487. Available from: <https://doi.org/10.22543/2392-7674.1487>.