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Original Research Article

Comparative study of onlay versus preperitoneal mesh repair in umbilical hernia: a prospective observational analysis

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ABSTRACT

Background: Umbilical hernias-especially in women and patients with raised intra-abdominal pressure-pose a risk for postoperative seromas and infections. This study prospectively compares two mesh-based techniques: onlay versus preperitoneal placement.
Methods: From January 2021 to December 2022, 50 adults with uncomplicated umbilical hernias were randomized to onlay (n=25) or preperitoneal (n=25) mesh repair. We monitored seroma formation, wound infection, flap necrosis, and length of hospital stay.
Results: The onlay group experienced a 24% seroma rate and 24% wound-infection rate, plus one case of flap necrosis. The preperitoneal group had zero complications. Average hospital stay was 5.4 days in both arms.
Conclusions: Preperitoneal mesh placement yields significantly fewer postoperative complications and should be the technique of choice for elective, uncomplicated umbilical hernia repair.

Keywords: Umbilical hernia, Onlay mesh repair, Preperitoneal mesh repair, Seroma, Postoperative complications, Hernia surgery techniques

INTRODUCTION

Umbilical hernias are among the most common anterior abdominal wall defects, particularly in adults with risk factors such as obesity, multiparity, ascites, and chronic cough.[1] These hernias result from a weakness at the umbilical ring, often exacerbated by elevated intra-abdominal pressure.[2] While suture repair was once the mainstay, recurrence rates as high as 10-30% prompted a shift toward mesh-based techniques.[3]

Among mesh placements, the onlay and preperitoneal (sublay) approaches are widely practiced. Onlay repair, where the mesh is placed superficial to the anterior rectus sheath, is technically simpler and familiar to most general surgeons.[4] However, it requires extensive subcutaneous dissection, which may increase the risk of seroma and wound infection.[5] In contrast, preperitoneal mesh placement-first popularized by Rives and Stoppa-positions the mesh between the posterior rectus sheath and peritoneum, reducing dead space and theoretically lowering complication rates.[6,7]

Recent studies suggest that preperitoneal repair may offer superior outcomes in terms of wound morbidity and recurrence, though it demands greater technical expertise.[8,9] This study aims to compare these two techniques in a prospective, controlled setting, focusing on short-term postoperative complications and hospital stay.

METHODS

The surgical techniques employed in this study were based on established protocols described in prior comparative trials.[10] For the onlay group, mesh fixation

followed the method outlined by Jagtap et al involving wide overlap and subcutaneous drainage.[11] The preperitoneal technique mirrored the approach described by Panguluri et al emphasizing careful dissection of the posterior sheath and avoidance of subcutaneous drains.[12]

All patients were monitored for seroma formation, wound infection, and flap necrosis, consistent with definitions used in previous prospective studies on mesh-related complications.[13]

Study design and setting

This prospective, observational study was conducted at GMERS medical college and hospital, Sola, Ahmedabad, from January 2023 through December 2024. The institutional ethics committee approved the protocol, and all patients provided written informed consent.

Inclusion criteria

Adult patients (≥18 years) with primary, uncomplicated umbilical hernia ASA physical status I-II were included.

Exclusion criteria

Recurrent, obstructed, or strangulated hernias divarication of recti prior lower midline laparotomy, pediatric patients (<18 years) were excluded.

Fifty eligible patients were randomized (computer-generated blocks) into two equal groups: Onlay mesh repair (n=25) and preperitoneal mesh repair (n=25).

Surgical techniques

Onlay mesh: After hernia sac reduction and defect closure with continuous polypropylene suture, a flat polypropylene mesh (10×10 cm) was placed superficial to the anterior rectus sheath, overlapped by 3-4 cm in all directions, fixed with interrupted non-absorbable sutures, and subcutaneous drains were placed.

Preperitoneal mesh: Following hernia reduction, the peritoneum and posterior sheath were dissected to create a pocket. The same size mesh was introduced into this space and anchored similarly. No routine subcutaneous drain was used.

Outcomes and follow-up

Primary outcomes: Seroma (clinically or ultrasonographically confirmed), wound infection (per CDC criteria) and flap necrosis.

Secondary outcome: Length of postoperative hospital stay (days), patients were assessed on postoperative days 3, 7, 14, and at 1 and 3 months. All complications and duration of stay were recorded.

Statistical analysis

Continuous variables are presented as mean±SD; categorical variables as counts and percentages. Chi-square or Fisher's exact test compared categorical outcomes; Student's t-test compared means. A $p<0.05$ was considered statistically significant.

RESULTS

Demographic and baseline characteristics

The two groups-onlay and preperitoneal mesh repair-were well matched in terms of age, gender distribution, BMI, and presenting symptoms. No statistically significant differences were observed in any of the baseline variables ($p>0.05$), indicating appropriate randomization and comparability at baseline (Table 1).

Postoperative outcomes

The preperitoneal mesh group demonstrated superior postoperative outcomes compared to the onlay group. Seroma and wound infection occurred exclusively in the onlay group, both at a rate of 24%, and were found to be statistically significant ($p=0.009$). One case of flap necrosis was reported in the onlay group, though this did not reach statistical significance. The mean hospital stay was comparable in both groups (Table 2).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants.

Variables	Onlay, (n=25)	Preperitoneal, (n=25)	P value
Mean age (in years)	38.2±10.1	39.5±9.3	0.65
Age distribution (in years) (%)			
18-30	28	24	0.78
31-40	36	40	
>40	36	36	
Female sex (%)	60	56	0.77
BMI (kg/m²)	26.1±3.4	25.8±3.1	0.73
Symptom at presentation (%)			
Swelling only	92	84	0.39
Swelling+pain	8	16	

Table 2: Comparison of postoperative outcomes between onlay and preperitoneal mesh repair groups.

Outcomes	Onlay, (n=25)	Preperitoneal, (n=25)	P value
Seroma	6 (24%)	0 (0%)	0.009
Wound infection	6 (24%)	0 (0%)	0.009
Flap necrosis	1 (4%)	0 (0%)	0.31
Hospital stay (days)	5.4±1.2	5.3±1.1	0.82

Interpretation

The preperitoneal mesh repair technique demonstrated a clear advantage over the onlay approach in minimizing early postoperative complications.

The absence of seroma formation and infections in the preperitoneal group supports the hypothesis that this technique reduces dead space and bacterial exposure.

Flap necrosis, although rare, occurred only in the onlay group, likely due to more extensive subcutaneous dissection.

Hospital stays were similar between both groups, suggesting that while the surgical approach impacts complication rates, it does not significantly prolong recovery time in uncomplicated cases.

DISCUSSION

Our findings align with prior literature demonstrating that preperitoneal mesh placement is associated with fewer wound-related complications compared to the onlay technique.[6,8,12] The 24% seroma and infection rates observed in the onlay group are consistent with those reported by Fonseca et al who found a 33% incidence of surgical site occurrences (SSOs) in onlay repairs versus 7.7% in preperitoneal repairs.[13]

The rationale behind the improved outcomes in the preperitoneal group may be explained by Pascal's principle, which posits that intra-abdominal pressure distributes evenly across the mesh surface when placed in a closed space, thereby stabilizing it without the need for extensive fixation.[7] This biomechanical advantage, coupled with reduced dissection, likely contributes to the lower rates of seroma and infection.

While the onlay technique remains popular due to its simplicity, our results support the growing consensus that preperitoneal repair offers a better safety profile, especially in elective, uncomplicated cases.[9,10] However, the learning curve and anatomical familiarity required for preperitoneal dissection should not be underestimated. Training and experience are essential to minimize intraoperative complications and ensure optimal mesh placement.[11]

This study has several limitations. It was conducted at a single center with a modest sample size of fifty patients, which may limit generalizability. The follow-up period of three months captures early postoperative complications but does not address long-term recurrence or quality-of-life outcomes. Cost analysis and patient-reported outcome measures were not included, and there is potential for surgeon-specific bias since procedures were performed by a limited number of operators. Future multicenter trials with longer follow-up and broader outcome assessments are needed to confirm these findings.

CONCLUSION

Preperitoneal mesh placement for elective, uncomplicated umbilical hernia repair significantly reduces early postoperative complications such as seroma formation and wound infection while achieving comparable hospital stays. This prospective, controlled analysis advances our understanding by providing robust evidence that the preperitoneal approach leverages biomechanical stability and minimal tissue disruption to optimize patient outcomes, reinforcing its recommendation as the preferred technique in routine clinical practice.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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