

ORIGINAL PAPER

Preventing parastomal hernia following radical cystectomy with ileal conduit diversion: outcomes of prophylactic mesh reinforcement

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Introduction Parastomal hernia (PH) is a frequent long-term complication following radical cystectomy with ileal conduit urinary diversion. Evidence supporting preventive strategies in urologic surgery remains limited. This study evaluated the impact of prophylactic mesh reinforcement during ileal conduit formation on PH incidence and postoperative outcomes.

Material and methods In this prospective, single-center cohort study, 70 patients undergoing open radical cystectomy with ileal conduit diversion were included. Prophylactic retromuscular mesh was placed at the stoma site in 10 patients (mesh group), while 60 patients underwent standard stoma construction (control group). The primary endpoint was PH occurrence. Secondary endpoints included stomal, bowel, wound, and infectious complications. Multivariable logistic regression was performed to identify predictors of PH in the control cohort.

Results PH occurred in 20 of 60 patients (33.3%) in the control group and in none of the patients in the mesh group (0%), representing a statistically significant difference ($p = 0.043$). Overall stomal complications were significantly reduced in the mesh group (0% vs 36.7%; $p = 0.025$). Operative time was significantly longer in the mesh group; however, no increase in bowel, wound, infectious complications, transfusion requirement, or reoperation rate was observed. Multivariable analysis identified increasing age, higher body mass index, and female sex as independent predictors of PH. Obese patients (BMI >30) demonstrated a significantly higher PH incidence compared with non-obese patients (42.9% vs 28.2%; $p = 0.032$).

Conclusions Prophylactic mesh reinforcement during ileal conduit formation significantly reduced parastomal hernia incidence and overall stomal complications without increasing perioperative morbidity.

Key Words: radical cystectomy <> ileal conduit <> parastomal hernia <> urinary diversion <> prophylactic mesh <> hernia prevention <> uro-oncologic surgery

INTRODUCTION

Radical cystectomy with ileal conduit diversion remains the standard surgical treatment for muscle-invasive bladder cancer and selected cases of non-muscle-invasive disease [1]. Despite continuous refinement of perioperative pathways and surgical techniques, urinary diversion carries substantial

long-term morbidity. Among the most frequent and clinically significant complications is parastomal hernia (PH), defined as the protrusion of intra-abdominal contents adjacent to the stoma (Figure 1). Reported PH incidence after ileal conduit diversion ranges widely from 10% to 50% [2–4], reflecting variability in diagnostic methods, imaging criteria, and follow-up duration.

The clinical burden of PH is considerable. Patients frequently experience pain, difficulties with appliance fitting, peristomal skin complications, urine leakage, and reduced social functioning [5]. Severe cases may progress to bowel incarceration or strangulation, requiring urgent surgical repair. Even when elective repair is feasible, recurrence rates approach 50–70%, making PH a persistent and challenging problem [6–8]. Consequently, PH contributes significantly to long-term morbidity, decreased quality of life, and increased healthcare costs [9]. Multiple risk factors for PH formation have been proposed, including elevated body mass index (BMI), female sex, low preoperative albumin, a larger fascial aperture, prolonged operative time, and prior abdominal surgery [2, 4, 10]. Because many of these risk determinants are not easily modifiable and patient-related factors cannot be fully optimized preoperatively, attention has increasingly turned toward intraoperative preventive strategies. In colorectal surgery, prophylactic mesh reinforcement of the stoma site has gained substantial support. Several randomized controlled trials and meta-analyses have demonstrated significant reductions in PH incidence without increased mesh-related complications [11–13]. These findings have shaped international guidelines and gradually altered clinical practice in stoma surgery outside urology. In contrast, evidence for prophylactic mesh use during ileal conduit creation remains limited but promising. Urinary diversion poses unique challenges: proximity to the ureteroenteric anastomoses, exposure to urine, and concerns about potential infectious or fistulizing complications. Despite these theoretical risks, emerging data suggest that prophylactic mesh reinforcement in ileal conduit diversion may substantially reduce PH incidence without increasing postoperative morbidity [14–17]. Given the high prevalence, clinical burden, and difficult management of PH, together with the need for more robust data in the urologic domain, evaluating preventive strategies is of substantial clinical importance. The present study investigated whether prophylactic mesh placement during ileal conduit construction reduces the incidence of PH compared with standard technique, and assessed associated perioperative and postoperative outcomes in a contemporary surgical cohort.

MATERIAL AND METHODS

Study design and patient population

This prospective, single-center cohort study included consecutive adult patients undergoing open radi-

cal cystectomy with ileal conduit urinary diversion at a tertiary academic urology department between February 2021 and June 2024. Patients were allocated to one of two groups based on the surgical technique used during ileal conduit formation:

- Mesh group, in which a prophylactic retromuscular mesh was implanted at the stoma site; and
- Control group, in which standard stoma construction without mesh reinforcement was performed.

Patients undergoing cystectomy for benign indications or receiving continent urinary diversion were excluded.

Surgical technique

All operations were performed using an open mid-line approach. Ileal conduit reconstruction was carried out according to the Bricker–Wallace technique. Ureteroenteric anastomoses were constructed bilaterally with internal stents left *in situ*.

In the mesh group, a specifically designed monofilament, macroporous, polyvinylidene fluoride-based retromuscular mesh (DynaMesh, FEG Textiltechnik, Aachen, Germany) was placed in a pre-peritoneal retromuscular position around the stoma aperture (Figure 2). The mesh was shaped according



Figure 1. Schematic representation of a parastomal hernia.

to the manufacturer's recommendations and secured using a small amount of tissue adhesive (Glubran 2, GEM, Viareggio, Italy), without fixation sutures. Stoma maturation was identical in both groups. All procedures were performed by two high-volume surgeons experienced in open urinary diversion.

Perioperative management followed an Enhanced Recovery After Surgery (ERAS) protocol, including preoperative counselling and immunonutrition, avoidance of mechanical bowel preparation, multimodal analgesia, early enteral feeding, and early mobilization.

Data collection

Demographic, clinical, perioperative, and postoperative variables were collected prospectively. Baseline variables included age, sex, BMI, comorbidities (ischemic heart disease, hypertension, diabetes mellitus, dyslipidemia, smoking status), tumor stage, and receipt of neoadjuvant or adjuvant chemotherapy.

Perioperative outcomes included operative time, intraoperative blood loss, transfusion requirement, and length of hospital stay. Postoperative complications were recorded up to 30 days and categorized according to the Clavien–Dindo classification. Long-term follow-up included clinical evaluation and cross-sectional

imaging (CT) to assess for PH. PH was defined radiologically as displacement of intra-abdominal contents adjacent to the stoma, corresponding to the European Hernia Society criteria [11].

Outcome measures

The primary endpoint was the incidence of PH during follow-up. Secondary endpoints included postoperative stomal complications (stenosis, prolapse, necrosis), bowel complications (prolonged postoperative ileus, mechanical obstruction, bowel leak), wound complications (infection, dehiscence), postoperative collections (hematoma, urinoma, lymphocele, abscess), urinary tract infection, need for transfusion, and reoperation.

Statistical analysis

Continuous variables were summarized as median and range (min–max) and compared between groups using the Mann–Whitney U test. Categorical variables were presented as absolute counts and percentages and analyzed using Fisher's exact test or the χ^2 test where appropriate.

To evaluate predictors of PH in the control group, multivariable logistic regression was performed, incorporating clinically relevant variables (age, BMI, ischemic heart disease, hypertension, diabetes, dyslipidemia, smoking). Odds ratios with 95% confidence intervals were calculated. In analyses where one group contained zero events, the Haldane–Anscombe correction was applied to enable model convergence.

A two-sided p-value <0.05 was considered statistically significant. Statistical analyses were performed using standard statistical software (NCSS statistical software version 10; 2015 NCSS LLC).

Bioethical standards

All patients provided written informed consent. The study protocol was approved by the University Hospital Hradec Kralove Ethics Committee (approval number: 202410 P02) and conducted in accordance with the Declaration of Helsinki.

RESULTS

Patient characteristics

A total of 70 patients were included, of whom 10 (14.3%) underwent prophylactic mesh placement during ileal conduit formation and 60 (85.7%) received standard stoma construction without mesh.

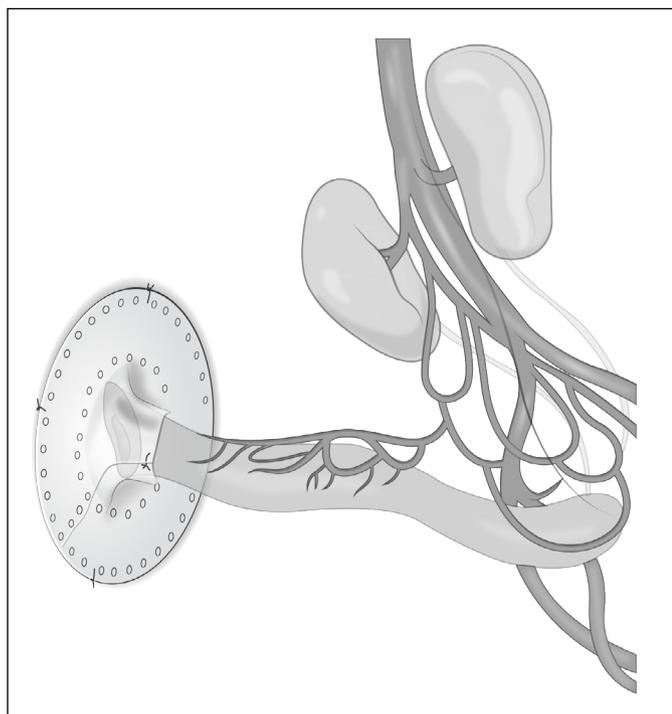


Figure 2. Schematic illustration of prophylactic mesh placement during ileal conduit creation.

Baseline demographic and clinical characteristics were comparable between groups (Table 1). There were no significant differences in age (median 71 vs 69.5 years; $p = 0.226$) or BMI (median 26.2 vs 27.7 kg/m²; $p = 0.712$). The prevalence of comorbidities – including ischemic heart disease, hypertension, diabetes, dyslipidemia, and smoking – did not differ significantly between groups (Table 2, all $p > 0.3$).

The median follow-up duration was longer among controls compared with mesh patients (47.0 vs 28.5 months; $p = 0.014$). Operative time was significantly longer in the mesh group (median 235.5 vs 178.5 minutes; $p = 0.001$), whereas intraoperative blood loss and length of hospitalization were similar between groups.

Incidence of parastomal hernia

During follow-up, PH occurred in 20 of 60 patients (33.3%) in the control group and in 0 of 10 patients (0%) in the mesh group (Table 3). The difference between groups was statistically significant ($p = 0.043$, Fisher's exact test).

Stomal and surgical complications

When evaluating all stomal complications combined (PH, stenosis, prolapse, necrosis), 22 of 60 patients (36.7%) in the control group experienced at least one event vs 0 of 10 (0%) in the mesh group, representing a significant reduction ($p = 0.025$).

Rates of bowel-related complications—including prolonged postoperative ileus, mechanical obstruction, and bowel leak—were comparable between groups ($p = 0.443$). Similarly, wound complications (infection or dehiscence) occurred at similar frequencies ($p = 0.730$), and the incidence of postoperative collections (hematoma, urinoma, lymphocele, abscess) showed no group differences ($p = 1.000$).

Urinary tract infection within 30 days occurred in 45.0% of controls and 40.0% of mesh patients ($p = 1.000$). There were no significant differences in transfusion requirement ($p = 0.582$) or reoperation within 30 days ($p = 0.583$). No mesh-related or mesh-associated infectious complications were observed.

Predictors of parastomal hernia in the control cohort

Multivariable logistic regression analysis performed within the control cohort ($n = 60$) identified several independent predictors of PH development (Table 4).

Increasing age was significantly associated with a higher risk of PH (OR = 1.14 per year; 95% CI: 0.98–1.44; $p = 0.02$). Similarly, higher BMI was an independent predictor of PH (OR = 1.18 per kg/m²; 95% CI: 0.96–1.37; $p = 0.01$). Female sex was also associated with an increased likelihood of PH occurrence (OR = 1.20; 95% CI: 0.97–2.62; $p = 0.04$). In the control cohort, patients with obesity (BMI >30) exhibited a significantly higher incidence of PH compared with those with BMI ≤30 (42.9% vs 28.2%). This difference was statistically

Table 1. Baseline and perioperative characteristics

Variable	Control (n = 60)	Mesh (n = 10)	p value
Age [years]	69.5 (39.0–81.0)	71.0 (66.0–79.0)	0.226
Female sex [n (%)]	11 (18.3)	2 (20.0)	1.000
BMI [kg/m ²]	27.7 (17.5–37.0)	26.2 (19.0–40.3)	0.712
Follow-up [months]	47.0 (4.0–70.0)	28.5 (10.0–42.0)	0.014
Operative time [min]	178.5 (115.0–313.0)	235.5 (180.0–266.0)	0.001
Blood loss [ml]	400 (100–1,500)	400 (100–900)	0.593
Length of stay [days]	14 (7–42)	14 (8–18)	0.404

BMI – body mass index

Continuous variables are presented as median (range), and categorical variables as number (percentage).

Table 2. Comorbidities and oncological treatment

Variable	Control (n = 60) n (%)	Mesh (n = 10) n (%)	p-value
Ischemic heart disease	14 (23.3)	3 (30.0)	0.696
Hypertension	47 (78.3)	7 (70.0)	0.685
Diabetes mellitus	24 (40.0)	5 (50.0)	0.731
Dyslipidemia	30 (50.0)	7 (70.0)	0.315
Current or former smoker	37 (61.7)	4 (40.0)	0.299
Neoadjuvant chemotherapy	15 (25.0)	0 (0.0)	0.105
Any adjuvant systemic therapy	12 (20.0)	2 (20.0)	1.00
TNM classification			
T stage			
T0	3 (5.0)	0 (0.0)	0.405
Ta	1 (1.7)	1 (10.0)	
Tis	2 (3.3)	1 (10.0)	
T1	5 (8.3)	1 (10.0)	
T2	20 (33.3)	2 (20.0)	
T3	20 (33.3)	5 (50.0)	
T4	9 (15.0)	0 (0.0)	
N stage			
N0	42 (70.0)	7 (70.0)	0.779
N1	5 (8.3)	0 (0.0)	
N2	13 (21.6)	3 (30.0)	
N3	0 (0.0)	0 (0.0)	

Categorical variables are presented as number (percentage)

significant (OR = 2.0, Fisher's exact $p = 0.032$), indicating an increased risk of PH among obese patients.

In contrast, hypertension (OR = 1.01; 95% CI: 0.27–7.11; $p = 0.70$) and diabetes mellitus (OR = 1.03; 95% CI: 0.38–5.26; $p = 0.60$) were not significantly associated with PH development.

DISCUSSION

In this prospective cohort study, prophylactic mesh placement during ileal conduit formation was associated with a significant reduction in PH, with no PH observed in the mesh group compared with an incidence of 33.3% in patients undergoing standard stoma construction. This difference was statistically significant despite the relatively small size of the

mesh cohort. In addition, when all stomal complications were evaluated collectively, mesh reinforcement resulted in a significant overall reduction compared with controls. These benefits were achieved without an increase in bowel, wound, infectious, or reoperation-related complications, underscoring the safety and feasibility of prophylactic mesh use in the urologic setting. Although operative time was significantly longer in the mesh group, this increase was attributable to the additional steps required for mesh preparation and placement and did not translate into higher perioperative morbidity.

The incidence of PH in our control cohort (33.3%) aligns with previously reported ranges of 10–50% after ileal conduit diversion [2–4]. The variability in published rates reflects differences in surveillance protocols, length of follow-up, and diagnostic modality. Most contemporary studies employing CT-based assessment report higher PH rates, a finding consistent with our results. The clinical burden of PH is well established, with symptoms ranging from cosmetic deformity to appliance leakage, pain, and, in some cases, bowel incarceration requiring urgent surgical repair [5–8]. Such complications, coupled with high recurrence rates after hernia repair, highlight the importance of preventive measures rather than reactive interventions.

Evidence for prophylactic mesh reinforcement of stoma sites is strongest in colorectal surgery, where multiple randomized controlled trials have demonstrated marked reductions in PH incidence without an increase in mesh-related morbidity [11–13]. By comparison, the urologic literature remains limited. However, several recent studies – including systematic reviews and a randomized controlled trial – have shown that mesh placement during ileal conduit diversion may substantially reduce PH incidence [14–17]. Our findings corroborate these observations, strengthening the emerging body of evidence that the theoretical concerns surrounding mesh placement near urinary and bowel anastomoses may be overstated when modern macroporous, monofilament meshes are used.

No mesh-related infectious complications were observed in our cohort. This is noteworthy given the historical reluctance to implant foreign material near the urinary tract and bowel. The retromuscular/subfascial mesh position used in this study may contribute to reduced contamination risk by providing mechanical reinforcement while maintaining separation from the conduit lumen. Furthermore, all operations were performed under ERAS protocols by high-volume surgeons, which may have mitigated known contributors to postoperative morbidity.

Table 3. Postoperative outcomes and complications

Outcome	Control (n = 60) n (%)	Mesh (n = 10) n (%)	p-value
Parastomal hernia	20 (33.3)		
EHS type I	15 (25.0)	0 (0.0)	0.043
EHS type III	5 (8.3)		
Any stomal complication*	22 (36.7)	0 (0.0)	0.025
Any bowel complication [†]	15 (25.0)	4 (40.0)	0.443
Any wound complication [‡]	24 (40.0)	3 (30.0)	0.730
Any postoperative collection [§]	9 (15.0)	1 (10.0)	1.000
Urinary tract infection <30 days	27 (45.0)	4 (40.0)	1.000
Perioperative blood transfusion	7 (11.7)	0 (0.0)	0.582
Reoperation <30 days	6 (10.0)	0 (0.0)	0.583

EHS – European Hernia Society

*Any stomal complication – parastomal hernia, stomal stenosis, prolapse, or necrosis

[†]Any bowel complication – prolonged postoperative ileus, mechanical obstruction, or bowel leak

[‡]Any wound complication = wound dehiscence or infection

[§]Any collection = hematoma, urinoma, lymphocele, or abscess

Data are presented as number (percentage).

Table 4. Multivariable logistic regression for predictors of parastomal hernia in the control cohort (n = 60)

Variable	Odds ratio	95% CI	p-value
Age (years)	1.14	0.98–1.44	0.02
BMI (kg/m ²)	1.18	0.96–1.37	0.01
Female sex	1.20	0.97–2.62	0.04
Hypertension	1.01	0.27–7.11	0.70
Diabetes mellitus	1.03	0.38–5.26	0.60

BMI – body mass index

Odds ratios with 95% confidence intervals (CI) are reported. The dependent variable was the occurrence of parastomal hernia. All listed variables were entered simultaneously into the model.

In the control cohort, multivariable analysis identified age, BMI, and female sex as independent predictors of PH development. Increasing age and higher BMI were both significantly associated with a higher risk of PH, while female sex was also linked to an increased likelihood of hernia formation. In contrast, cardiometabolic comorbidities such as hypertension and diabetes mellitus were not associated with PH occurrence. These findings support the concept that PH formation is driven primarily by patient-related and biomechanical factors rather than by individual comorbid conditions alone, reinforcing the rationale for preventive strategies applied broadly rather than restricted to narrowly defined high-risk subgroups. Similar associations between demographic factors and PH risk have been inconsistently reported in previous studies, reflecting heterogeneity in patient populations and study designs [2, 10].

Obesity has been repeatedly implicated as a key contributor to PH formation, likely through mechanisms involving increased intra-abdominal pressure and altered abdominal wall biomechanics. In our cohort, patients with BMI >30 demonstrated a significantly higher incidence of PH compared with non-obese patients (42.9% vs 28.2%), corroborating the results of the multivariable regression analysis. This finding is consistent with earlier reports identifying obesity as a clinically relevant risk factor for PH following ileal conduit diversion and further supports the consideration of prophylactic mesh reinforcement, particularly in patients with elevated BMI.

This study has several strengths, including prospectively collected data, standardized surgical technique, and radiologic confirmation of PH. The inclusion of a relatively large control cohort enables meaningful comparison with the mesh group. Nonetheless, certain limitations must be acknowledged. The mesh cohort remained smaller, limiting the statistical power to detect differences in rare events and widening the confidence intervals in risk estimates. Follow-up duration was shorter in the mesh cohort, although PH often presents early and has been reported to occur predominantly within the first 12–24 months after diversion [5, 17].

Finally, the non-randomized design introduces the potential for selection bias, although baseline characteristics were well balanced between groups.

Despite these limitations, our findings contribute important clinical evidence supporting prophylactic mesh use during ileal conduit creation. The observed absence of PH, coupled with a favorable safety profile, suggests that mesh reinforcement may represent an effective strategy to reduce morbidity after radical cystectomy. Larger, multicenter randomized trials with long-term follow-up are warranted to confirm these results and to establish standardized recommendations for mesh selection, placement technique, and patient eligibility.

CONCLUSIONS

Prophylactic mesh reinforcement at the time of ileal conduit formation was associated with a significant reduction in stomal complications, including the complete prevention of PH, without increasing bowel, wound, or infectious morbidity. Despite the smaller size of the mesh cohort and differences in follow-up duration, the consistently favorable safety profile combined with a substantial effect size underscores the feasibility and clinical relevance of this preventive approach. These findings support the consideration of prophylactic mesh placement as part of contemporary urinary diversion surgery. Further large-scale, prospective randomized studies are required to confirm these results and to establish optimal mesh technique, positioning, and patient selection criteria for routine clinical practice.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

FUNDING

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ETHICS APPROVAL STATEMENT

The study protocol was approved by the University Hospital Hradec Kralove Ethics Committee (approval number: 202410 P02) and conducted in accordance with the Declaration of Helsinki.

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