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Outcomes of prophylactic chimney mesh in parastomal hernia prevention after colorectal cancer surgery: a retrospective single-center cohort study

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Background: Parastomal hernia (PSH) is the most common complication after permanent end colostomy, with a prevalence exceeding 50% without preventive measures. Funnel-shaped (chimney) mesh has been introduced to overcome limitations of the traditional retrorectus keyhole technique in PSH prevention, with promising results in recent studies. This study aimed to evaluate clinical and radiological outcomes and safety following prophylactic chimney mesh placement in a real-world cohort.

Methods: This retrospective cohort study included patients undergoing surgery for colorectal cancer with permanent end colostomy and prophylactic chimney mesh placement at Oulu University Hospital between May 2018 and November 2024. Patients participating in the Chimney Trial were excluded. The primary outcome was CT-confirmed PSH during follow-up. Secondary outcomes included clinical PSH, PSH classification (European Hernia Society and Moreno-Matias classifications), PSH-related symptoms, and stoma-related reoperations. CT scans were analyzed retrospectively by two radiologists.

Results: A total of 177 patients were included. CT imaging was available for 96 patients (54%), with a median follow-up of 12.6 months (IQR 12.1–13.7 months) from the primary operation. CT-confirmed PSH was present in 57/96 (59%) patients. Most PSHs were small or clinically insignificant, with 50/57 (88%) classified as Moreno-Matias 1a–1b and 56/57 (98%) EHS type 1 or 3. Clinically detectable PSH was seen in 9/177 patients (5%), and only 4/177 patients (2%) had PSH-related symptoms. No patients had surgery for PSH during the follow-up time. Three patients (3/177, 2%) underwent reoperation for stoma- or mesh-related complications.

Conclusion: From a clinical perspective, despite the high rate of CT-detected PSH, reoperation rates for PSH were low after prophylactic chimney mesh placement. These findings suggest that chimney mesh placement was associated with a low rate of clinically significant PSH, although radiological PSH remains common. Future studies should focus on clinically relevant and patient-reported endpoints rather than imaging findings alone.

KEYWORDS
colorectal cancer, hernia prevention, mesh, parastomal hernia, parastomal hernia prevention

Introduction

Parastomal hernia (PSH) is the most common complication in patients with a permanent end colostomy, with a prevalence exceeding 50% without preventive measures [1–3]. In recent PSH prevention studies, the retrorectus keyhole technique did not prevent PSH [4–7]. To overcome the challenges of the keyhole technique, a funnel-shaped (chimney) configuration of intra-abdominal mesh has been used for both PSH prevention and repair [8]. In the previously published cohorts and case series, a chimney mesh configuration has prevented a high number of PSHs without predisposing patients to complications [9–14]. The results of the randomized controlled Chimney Trial on PSH prevention with funnel-shaped mesh have been published, with the mesh significantly reducing both the clinical and CT-confirmed PSH rate compared to non-mesh controls at both the 12-month and 3-year follow-ups [2, 3].

The European Hernia Society recommends the use of synthetic non-absorbable prophylactic mesh with permanent colostomy to prevent PSH [15, 16]. The aim of this retrospective cohort study was to discover the results associated with chimney mesh application in PSH prevention after surgery for colorectal cancer in a single university hospital setting.

Materials and methods

This study describes the results of parastomal hernia prevention in a retrospective cohort of patients operated on for colorectal cancer with permanent end colostomy at Oulu University Hospital between May 2018 and November 2024. Ethical approval for the study was obtained prior to its initiation (Ethical Committee permission number §81/2021). The study period began in May 2018 with the first patient operated on using chimney mesh at Oulu University Hospital and ended in November 2024 so that the 12-month follow-up CT was available for study patients in November 2025 when the CT scan analysis was initiated.

All patients who underwent surgery for colorectal cancer with permanent colostomy and prophylactic mesh placement during the study period were identified from a prospectively maintained patient register and included in the study. Patients who participated in the Chimney Trial [2, 3] were excluded.

All patients with colorectal adenocarcinoma undergo routine follow-up, including a CT scan approximately 12 months after the primary operation, while clinical follow-up continues for up to 5 years. Clinical PSH and PSH-related symptoms were identified retrospectively from the patients' medical records during this follow-up period, and no standardized prospective clinical examination specifically for the purposes of this study was performed.

All available CT examinations were independently reviewed by two radiologists using a predefined standardized assessment protocol based on the same assessment form and criteria used in the randomized Chimney Trial [2, 3]. In cases of disagreement, the findings were discussed and a consensus decision was reached. The radiologists were not blinded to clinical information or the study setting. As Oulu University Hospital serves as a tertiary referral center for geographically approximately half of the country of Finland, some patients attend follow-ups at regional hospitals closer to their residence. Consequently, CT scans were not available for all patients in the registry. Reasons for not attending the CT scans at Oulu University Hospital were not recorded.

The patient registry was retrospectively reviewed for details regarding PSH symptoms, diagnosis and reoperations. CT scan analysis was performed retrospectively in accordance with the protocol used in the Chimney Trial [2, 3], with an addition of Moreno-Matias classification to the analysis [17].

A funnel-shaped prophylactic mesh (Dynamesh IPST®, FEG Textiltechnik mbH, Aachen, Germany) was used in all study cohort patients. The mesh consists of polyvinylidene fluoride and polypropylene and is designed for intra-abdominal placement with a funnel surrounding the bowel to reinforce the stoma site and prevent PSH. The mesh was placed at the end of the operation and secured to abdominal wall using absorbable tackers (SECURESTRAP™, Ethicon, Inc., Somerville, NJ, USA) in double crown configuration [2, 3].

The primary outcome was PSH on CT scan during the follow-up period. Secondary outcomes included PSH classification according to European Hernia Society (EHS) and Moreno-Matias classifications, clinically detected PSH, stoma-related reoperations and complications, as well as PSH-related symptoms.

Continuous variables are presented as means with standard deviations (SD) or medians with interquartile ranges (IQR) or ranges, as appropriate based on data distribution. Categorical variables are reported as frequencies and percentages.

The PSH rate with 95% confidence interval (95% CI) according to the Wilson method was calculated based on CT-confirmed and clinical findings during the follow-up period.

Statistical analyses were performed using IBM SPSS Statistics software (version 31, IBM Corp., Armonk, NY, USA).

Results

Between May 2018 and November 2024, 177 patients not participating in the Chimney Trial [2, 3] underwent abdominoperineal resection or Hartmann's procedure for rectal adenocarcinoma with prophylactic chimney mesh placement (Table 1).

A 12-month follow-up CT scan was available for 86 of 177 patients (49%). Additionally, 10 patients had a CT scan performed at another time point (6%). The median follow-up time from operation to CT scan was 12.6 months (IQR 12.1–13.7).

Among the 96 patients with available CT scans, 57 (59.4%, 95% CI 49.4%–68.7%) had CT-confirmed PSH. The distribution of PSHs according to the EHS and Moreno-Matias classifications is presented in Table 2. Among the 57 patients with CT-confirmed PSH, 50 (87.7%) had a Moreno-Matias type 1a or 1b PSH, containing only the bowel loop leading to the stoma. According to the EHS classification, 34/57 patients (59.6%) had a class 3 PSH (hernia defect ≥5 cm), 22/57 (38.6%) had a class 1 PSH (hernia defect <5 cm), and one patient (1.8%) had a class 4 PSH.

Of all 177 patients, 9 (5.1%, 95% CI 2.7%–9.4%) had a clinically detectable PSH recorded in their patient records during a median follow-up of 40.7 months (IQR 28.3–52.2 months). Of these, 4 (2%)

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TABLE 1 Patient characteristics.

	N = 96 (%)
Age (mean, SD)	68.7 ± 10.7
Sex	
Female	24 (25)
Male	72 (75)
Active smoker	17
Ex-smoker	35
Charlsson comorbidity index	
0	49 (51)
1	27 (28)
2	10 (10)
3	7 (7)
4	3 (3)
ASA class	
1	3 (3)
2	48 (50)
3	35 (37)
4	10 (10)
Time from operation to clinical data (months)	40.7 (28.3–52.2)
Time from operation to CT scan (months)	12.6 (12.1–13.7)
Operation	
APE	84
Hartmann	12
Approach	
Robotic	56
Laparoscopic	22
Open	15
Conversion	3

Nominal variables are reported as counts and percentages (in parenthesis); continuous variables are reported as medians and interquartile ranges (25th - 75th percentile). ASA, america society of anesthesiclogists score; APE, abdominoperineal excision.

TABLE 2 $^{-\Delta\Delta CT}$ scan data.

	N = 96 (%)	Range
CT at 12 months follow-up point	86 (90)	
CT at another follow-up point	10 (10)	
CT confirmed PSH	57 (59)	
EHS classification		
Type 1	22 (39)	
Type 2	0	
Type 3	34 (60)	
Type 4	1 (2)	
Moreno-mattias classification		
Class 1a	20 (35)	
Class 1b	30 (53)	
Class 2	6 (11)	
Class 3	1 (2)	
Fascia defect area (PSH)	9.1 ± 4.3	3.4–21.5
Fascia defect area (no PSH)	5.7 ± 3.0	1.7–13.9
PSH volume (cc)	88.5 ± 77.6	9.8–389.5
Distance from midline (mm)	65.0 ± 17.3	33.2–164.5

Nominal variables are reported as counts and percentages (in parentheses); continuous variables are reported as means and standard deviations. EHS, european hernia society; PSH, parastomal hernia. Percentages for the EHS, and Moreno-Matias classifications are calculated among patients with CT-confirmed PSH (n = 57).

patients were reported to have PSH symptoms, including pain (2 patients, 1%) and bulging without other symptoms (2 patients, 1%).

Three patients underwent reoperation due to stoma-related complications during follow-up. One patient developed stoma necrosis requiring removal of the prophylactic mesh. The stoma was retained at the same site without placement of a new prophylactic mesh, and a PSH subsequently developed during follow-up. One patient had stoma detachment from the skin, resulting in abdominal wall infection, colectomy, and end ileostomy in the early postoperative period. Additionally, one patient underwent emergency reoperation for internal herniation related to adhesions around the intra-abdominal mesh. Adhesiolysis alone was sufficient, and the mesh was left in place. No operations were done for only PSH.

Discussion

In this retrospective cohort, the incidence of CT-confirmed PSH after prophylactic chimney mesh placement was high (59%) at a median follow-up of 12.7 months. However, the rate of clinically relevant PSH remained low, with only 5% (9/177) of patients having clinically detectable hernia and only 2% (4/177) experiencing symptoms. Additionally, no patients with mesh were operated on for PSH during the follow-up time.

The use of chimney mesh has been proposed to overcome some of the limitations associated with the flat keyhole mesh configuration [9–14]. However, the CT-confirmed PSH rate remains high even with the chimney mesh [2, 3]. This finding highlights the limitations of CT-confirmed PSH as a primary end point. Clinically significant PSH, quality of life analysis and PSH-related symptoms may provide better end points for future studies.

The main limitations of this study are its retrospective, single-center design, which introduces the potential for selection and information bias and may limit the external generalizability of the findings. The retrospective data collection may also have resulted in underestimation of PSH-related symptoms, as clinical

PSHs may not have been systematically recorded in the patients' medical records. Additionally, the relatively small sample size and incomplete availability of CT follow-up are important limitations. The reasons for missing CT examinations were not systematically recorded, introducing a potential risk of selection bias in the radiological endpoint. Furthermore, the timing of CT assessment varied considerably, ranging from 1.6 to 30.6 months, which may have affected the incidence of CT-confirmed PSH.

In line with previous studies, prophylactic chimney mesh placement was associated with a low rate of clinically significant PSH. However, the clinical relevance of CT-confirmed PSH warrants further investigation.

Data availability statement

The data that support the findings of this study are available from the corresponding author, EM, upon reasonable request for collaboration. Requests to access the datasets should be directed to EM elisa.makarainen@pohde.fi.

Ethics statement

The studies involving humans were approved by Oulu University Hospital ethics committee. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin because this study is based on register data, and written informed consent was not required.

Author contributions

All authors contributed equally to the conceptualization, methodology, formal analysis, writing – original draft, and writing – review and editing of this manuscript. All authors contributed to the article and approved the submitted version.

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