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ORIGINAL ARTICLE

Prevention of parastomal hernia by the placement of a mesh at the primary operation

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Abstract
Introduction Parastomal hernia is a well known clinical problem, and up to 50% of all patients having a stoma will eventually develop a parastomal hernia. There are many surgical options available for the repair of a parastomal hernia, but the prevention of hernia development has only recently received scientific attention. The most encouraging results have included the use of a mesh inserted at the primary operation. We have, therefore, chosen to review the literature regarding the results of operative techniques, including mesh placement, for the prevention of a parastomal hernia.
Materials We performed a systematic literature search and found five publications which, in total, included 112 patients having a prophylactic mesh during their stoma formation. One study was a randomized controlled trial which included 54 patients, of which, 21 patients had a prophylactic mesh. The remaining four studies were prospective observational series.
Results Three of the 112 patients had a hernia recurrence within the follow-up period, which ranged from 2 to 48 months. One of the 52 patients that had a sublay mesh placed at the primary operation and two of 60 patients that had an onlay mesh developed a hernia. There were no infections or other serious complications related to the mesh in any of the studies.
Conclusion The results of placing a prophylactic mesh when performing a permanent stoma in the elective situation are very promising. However, the data are preliminary and with relatively short follow-up times. Therefore, it should be confirmed in larger, double-blinded, controlled randomized clinical trials whether there are short- and long-term advantages of placing a mesh at the primary operation, and where the mesh should be placed in the abdominal wall.

Keywords Prophylactic mesh · Parastomal hernia · Prevention · Onlay · Sublay

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Introduction

A parastomal hernia is defined as an incisional hernia related to an abdominal wall stoma [1]. Parastomal herniation is more common after colostomy formation (up to 48%) than after ileostomies (up to 21%) [2–4]. Although parastomal hernias usually give mild symptoms, many patients have symptoms necessitating surgery [5]. Before the mesh was introduced, several surgical procedures for the treatment of parastomal hernias were used, including relocation or local repair, but there are generally high complication rates of 24–88% and recurrence rates of 46–100% [2, 6, 7].

Small studies [8–10] indicate few complications and low recurrence rates of 0–28% with open local mesh repair using a non-absorbable or partly absorbable mesh. Laparoscopic parastomal hernia repair shows promising results, with recurrence rates of between 4 and 12% [10–17]. The studies are characterized by not being randomized, including few patients, having a short follow-up period, and only using expanded polytetrafluoroethylene (ePTFE) meshes. The complication rates were up to 30% and there was a tendency towards more serious complications, such as bowel injury and bowel or stoma obstruction.

Within the last couple of years, there have been encouraging reports in preventing parastomal hernias with few complications. In these studies, parastomal herniation has been prevented by placing a mesh in the abdominal wall at the primary operation [18–22]. The mesh has primarily been placed in an onlay or a sublay position to the fascia. The aim of the current paper was to review the literature describing the results of parastomal hernia prevention using a mesh.

Methods

The literature was searched systematically using PubMed/MEDLINE and EMBASE. The search terms used were "parastomal hernia" and "prevention." Since the primary search gave only a few hits, the search was extended in order to find additional literature that described the primary prevention of parastomal hernias. The search terms were, therefore, expanded to include "abdominal hernia and prevention" and "ventral hernia and prevention," as well as "incisional hernia and prevention," with human studies and the English language as limits. Any additional relevant studies from the reference lists of these papers were also included.

Surgical technique

Two different surgical procedures (the onlay and sublay techniques) of how to place the mesh at the primary stoma formation have been described, and we have, therefore, chosen to describe these two methods in detail [18, 19, 21, 22]. The goal is to reinforce the abdominal wall that surrounds the stoma, and, thereby, prevent herniation. The trephine is made in the middle of the mesh, and the size of the trephine is described as having a diameter approximately 0.5 cm larger than the bowel diameter [19, 21]. There is no consensus on how big the mesh overlap should be, but most reports from hernia repair surgery have a minimum of 5–6-cm overlap in all directions [13, 19, 21–25]. By placing a prosthetic mesh during the primary operation, the operation will be prolonged by approximately 15 min [18, 19, 22], independent of the technique.

Onlay mesh procedure

The onlay mesh is positioned on the external rectus fascia (Fig. 1). Two different onlay mesh procedures at the primary stoma making have been described in the literature [18, 19].

Bayer et al. [18] used a Marlex® (C.R. Bard Inc., Cranston, NJ, USA) polypropylene mesh at the primary operation to prevent parastomal hernia. The mesh was a ring with four arms. The width of the ring was 15 mm from the inner to outer circles. The inner circle formed a 20-mm-wide central hole to the bowel. The outer ring was fixated to the fascia with Marlex sutures and the arms were then bent as close as possible to the inner circle and then out towards the skin to form a cylinder around the bowel. The bowel was fixated onto the mesh in order to strengthen the colostomy.

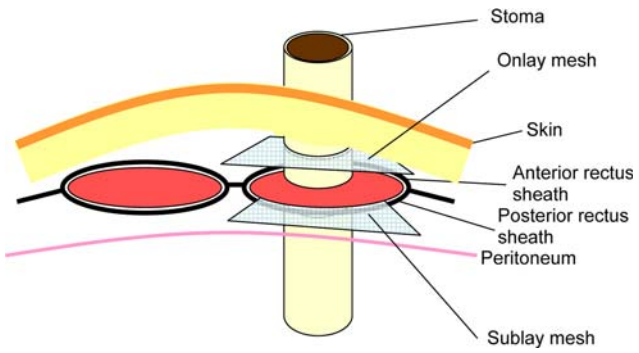

Fig. 1 Schematic drawing of where to position a mesh in order to prevent parastomal hernia

Gögenur et al. [19] used a specially developed circular heavyweight polypropylene mesh, StomaMesh™ (StomaMesh A/S, Svendborg, Denmark) with five arms. In the middle, there was a pre-cut hole with a diameter of approximately 5 mm larger than the bowel. After the circular skin incision, a cross-incision in the external rectus muscle was made. By making small peripheral skin incisions, it was possible to pull the arms of the mesh through the skin incisions superior to the external rectus fascia. Alternatively, the six arms can be placed on the fascia by pushing them in with a clamp, thereby, avoiding the six additional skin incisions. The mesh was embedded in Gentamicin and fixated to the fascia by four Prolene® (Ethicon, Piscataway, NJ, USA) sutures to the central ring. The bowel was then pulled through the central hole of the mesh and fixated by seromucocutaneous sutures with no fixation between the mesh and bowel.

Sublay mesh procedure

The sublay mesh can be positioned in different ways, either inside the abdomen, pre-peritoneal, or between the rectus muscle and the posterior rectus sheath (Fig. 1). The mesh is positioned by dissection through either the midline [20, 21] or the circular stoma incision [22]. Different mesh types have been used [20–22] and we found three publications describing the method. In all three studies, the mesh was placed between the rectus muscle and the posterior rectus sheath.

Jänes et al. [21] used the Vypro® mesh (Ethicon, Norderstedt, Germany), which is a lightweight mesh with low polypropylene content and high content of absorbable

material. The mesh was of size 10×10 cm. The bowel was brought out through a cross-cut in the center of the mesh. The mesh was placed by dissection through the midline incision between the rectus muscle and the posterior rectus sheath. The mesh was fixated in the corners and medial side by absorbable sutures.

Israelsson et al. [20] treated patients who had parastomal hernias by stoma relocation and a mesh, and since the stoma was relocated, we have considered it as a primary stoma formation regarding the prophylaxis of a new herniation. The new stoma was made using the same mesh and operative technique as Jänes et al. [21]. Because of the abdominal wall defect caused by the old hernia, this defect was reinforced by a non-absorbable mesh. This mesh was placed on both sides of the midline in the space between the rectus muscle and the posterior rectus sheath, and overlapped the abdominal wall defect by 5 cm in all directions. A U-shape was made to prevent contact between the bowel and the mesh. The partial absorbable Vypro mesh that surrounded the stoma was placed under the mesh that covered the old incisional/parastomal hernia.

Marimuthu et al. [22] placed the mesh through the stoma incision. After having made a circular incision, excised the subcutaneous tissue, and incised the anterior rectus sheath, the rectus muscle was split and a space was made between the rectus muscle and the posterior rectus sheath. In this space, they placed a Surgipro™ (Tyco Healthcare, Mansfield, MA, USA) polypropylene monofilament mesh. The mesh was of size 6×6 cm, with a central hole to the bowel. The mesh was not fixated by sutures to the fascia nor to the bowel.

Results

We found 21 studies in the primary literature search. In order not to overlook any studies, the search was expanded and by combining "prevention" with "abdominal ventral hernia," "ventral hernia," and "incisional hernia," we found 116, 199, and 125 references, respectively, but it did not produce any new references that met our inclusion criteria. After we went through the hits, we only found five references where primary mesh at the stoma formation was used to prevent parastomal hernia. The rest of the papers were excluded either because they only described the technique or they were concerning the repair of parastomal or incisional hernias and not prevention. Four studies were prospective [19, 22] or retrospective [18, 20] without a control group, and one study had a control group [21]. All of the studies concerned open surgery and there were no studies of primary mesh placement by laparoscopic technique.

The only randomized clinical trial was by Jänes et al. [21] (see Table 1). They included 54 patients, 27 with mesh and 27 without. The two groups were comparable concerning general (body mass index [BMI], age, sex) and operative characteristics. The patients were mainly operated electively for malignant tumors, but also patients who had acute surgery for non-malignant disease were included. Severe fecal contamination occurred in few of the operations. The total follow-up was mean 24 months, range 12–38 months. During the first 12 months, seven patients died of malignant disease. Twenty-six patients with conventional stoma surgery and 21 patients with mesh attended the 12 month follow-up. After 12 months, the results showed one hernia vs. 13 hernias ($P < 0.001$) in favor of prophylactic mesh. No patients developed fistulas or significant pain in the mesh group, and there were no records of infections associated with the mesh. Because the results clearly favored prophylactic mesh, it was considered unethical to continue the randomized study, which was, therefore, terminated prematurely.

Israelsson [20] treated 13 patients, and, as mentioned, they were treated by mesh after relocation of the stoma. The patients were followed for a mean of 12 months (median 11 months), range 3–25 months. No patient had a parastomal or an incisional hernia recurrence, and one patient developed a wound infection.

Table 1 Articles describing parastomal hernia prophylaxis by mesh placement. The study by Jänes et al. [21] was a controlled study. The other studies were descriptive

Author	Patients	Operative technique	Follow-up (months)	Hernia recurrence	Complications related to mesh
Bayer et al. [18]	36	Onlay	Up to 48	0	2 (one had a narrow stoma, one had stitch granuloma)
Gögenur et al. [19]	24	Onlay	Median 12 (range 2–26)	2	2 (both patients had mesh-arm penetration through the skin)
Israelsson [20]	13	Sublay	Mean 12	0	1 (wound infection)
Jänes et al. [21]	21	Sublay	Mean 24	1	0
Marimuthu et al. [22]	18	Sublay	Mean 16	0	0
Total	112			3	5

In a prospective study by Marimuthu et al. [22], 18 patients were followed for a mean of 16 months, range 6–28 months. Elective patients scheduled for a permanent stoma were included and were operated by the same surgeon. No patients had severe fecal contamination of the peritoneal cavity or at the stoma site. Three patients had ileostomies and 15 had colostomies. One patient had a stoma necrosis and was re-operated after 2 days, leaving the mesh in situ. There were no parastomal hernias, no fistula formations, and no infections or stoma obstruction associated with the mesh during the follow-up period.

Bayer et al. [18] was the first study to describe parastomal hernia prevention by using a mesh. They retrospectively recorded 36 patients operated by this method. No mean follow-up period was described, but some patients were followed for 4 years. No patients had parastomal hernias during follow-up. Three patients had local infection around the colostomy and were treated by drainage and antibiotics, but the authors did not state whether the infections were related to the mesh or not. One patient had the mesh removed because it narrowed the colostomy, and one patient had a small stitch granuloma removed after 2 years.

Gögenur et al. [19] included 24 patients, who were followed for a median of 12 months, range 2–26 months, after surgery. All operations were elective and the patients were all operated for rectosigmoid neoplasia with a planned permanent end-colostomy. No immediate complications related to the mesh were recorded. During the follow-up, two patients had a mesh penetration through the skin by one of the arms of the mesh. The penetrated part of the mesh was removed under local anesthesia, with no further complications. Two patients had clinical and objective signs of parastomal hernia in the follow-up period with cosmetic complaints. No patients had bowel strictures, fistulas, inflammatory reactions, or infections in association with the mesh or the stoma.

Discussion

Jänes et al. showed, in a randomized study, that only 5% of patients in the mesh group developed a parastomal hernia, compared to 50% in the non-mesh group at 12 months follow-up [21]. No complications to the mesh were recorded, including any infections. As in many other studies, they had a short follow-up, but a 5-year follow-up is planned. The study had some methodological limitations, caused by the lack of double-blinding of the patients and the surgeon who performed the clinical examinations at the follow-up. Parastomal hernia is a clinical diagnosis; however, they used no paraclinical investigations to support the diagnosis. In the control group, there was also a remarkably high frequency of parastomal hernia.

The prospective study by Marimuthu et al. included 18 patients and they found no parastomal herniation or infections related to the mesh [22]. Again, the study had a relatively short follow-up period (6–28 months), and the patients were elective and specially selected for the procedure. This study also found that a prophylactic mesh could prevent the development of a parastomal hernia and with no increased risk of infectious complications.

In a study by Israelsson, 13 patients who had a parastomal hernia were selected to undergo stoma relocation and, at the same time, had a prophylactic mesh [20]. Because the stoma was relocated, we decided to regard it as a new stoma in our literature search. Nevertheless, the data cannot be used to make any conclusions about the operation technique and mesh type, since the treatment of the old abdominal defect also involved a mesh that, to a small degree, overlapped the prophylactic Vypro mesh. Israelsson found good hernia prevention, but the patients were not randomized and there was a very short follow-up period of mean 12 months.

The onlay procedure described by Gögenur et al. found good results regarding both the prevention of parastomal herniation and mesh complications [19]. The study was not randomized and had a short median follow-up period of 12 months. Furthermore, the mean BMI was 23, which may be lower than the BMI of the general surgical patients undergoing colonic surgery. Two patients had mesh penetration through the skin, but this could probably be avoided if the mesh was put in place with a clamp and not making any peripheral skin incisions. Two patients (8%) had clinical signs of a parastomal hernia at 6 and 12 months follow-up, respectively. In this study, the mesh was embedded in Gentamicin as an extra safety measure to prevent infections, although there are no data to support this in the literature.

Bayer et al. also found positive results by using a mesh to prevent parastomal hernia. However, the patient selection and data were not described in detail, and the follow-up was not mentioned [18]. Nevertheless, the study indicated that a mesh may be preferable to avoid parastomal hernia.

It is often discussed whether the hole in the mesh to the bowel will become lager over years and give rise to the risk of herniation, so different methods have been developed to prevent that. Some authors have reinforced the hole with a ring [23] or a suture [24], and others by making mesh flaps [25] to reduce the friction against the bowel. However, there is no evidence that hole enlargement is an actual clinical problem. There are no studies of primary mesh placement by laparoscopic technique, but both the onlay and sublay procedures are suitable for laparoscopic surgery and the sublay procedure is already used in the repair of parastomal hernia [15, 26].

Before we use the procedure on all of our patients who need a terminal stoma, further studies are needed. Most parastomal hernias appear a few years after surgery, but may occur up to 10 years after the operation [2]. Longer follow-up is, therefore, needed in future studies. In the studies mentioned, the authors have used different meshes, and they seem to be comparable regarding complications and hernia prevention. Nevertheless, many different meshes are available on the market and large randomized studies should, therefore, explore the risk of herniation and general complication rates with different mesh materials. Another aspect is whether a sublay or onlay technique should be used, and this should obviously be studied in a randomized design.

Only a few patients in the published studies had severe fecal contamination during their operations. So, even though no infections were found involving the meshes, it should be studied whether it is recommendable to give patients with massive fecal contamination a prophylactic mesh. Almost all patients in the published literature were operated electively, and further studies should, therefore, also include patients undergoing acute surgery.

Elderly patients are known to have a greater risk for the development of a parastomal hernia [4, 27], but there is no firm evidence yet that patients with, e.g., obesity or chronic lung disease have an increased risk of parastomal hernia, primarily because of the relatively small number of studies published. It may turn out that risk factors for the development of a parastomal hernia can be extrapolated from the general ventral hernia risk factors, but this is also to be clarified in future large-scale studies

The current literature shows that the risk of parastomal hernia is minimized by using a mesh at the primary operation. However, since only 50% of patients will develop a parastomal hernia by using ordinary non-mesh techniques, there is a risk of overtreatment if all patients receive a prophylactic mesh. Therefore, it is essential to evaluate which patients are at a greater risk of developing a parastomal hernia, especially because current parastomal hernia treatment by laparoscopic mesh technique has shown low recurrence rates, and there are few, but serious, complications. It may be preferable to place a mesh at the primary operation when performing a permanent stoma because it seems to have few complications and is easy to perform. Also, the procedure only prolongs the operation by approximately 15 min.

In conclusion, based on the data available (one controlled study and four descriptive studies), the placement of a prophylactic mesh at the primary operation is a safe procedure, with very few complications. The placement of a prophylactic mesh seems to reduce parastomal herniation. However, the data should be confirmed in larger, double-blinded, randomized clinical trials with long-term follow-up before final recommendations can be made. Other important issues also need scientific attention in the near future, e.g., choice of mesh material, mesh design, and the best placement of the mesh (onlay versus sublay).

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