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Application of methylene blue guidance combined with closed negative pressure drainage in the treatment of inguinal hernia mesh infection

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Abstract

Purpose: To explore the application and effect of methylene blue guidance combined with closed negative pressure drainage in the treatment of inguinal hernia mesh infection.

Method: The clinical data of 38 patients with mesh infection after inguinal hernia repair who were admitted to the Department of Vascular Thyroid Hernia and Abdominal Wall Surgery of Guangdong General Hospital from January 2015 to June 2019 were retrospectively analyzed. Among them, 38 patients were treated with methylene blue guidance combined with negative pressure drainage and debridement. We evaluated the clinical characteristics and wound healing degree of all patients after primary suture of postoperative wounds, and their average operation time, average hospital stays and postoperative complications were recorded to evaluate the therapeutic effect.

Result: Methylene blue injection into sinus was adopted for all patients, followed by removal of all methylene blue stained sinus and tissue, postoperative primary suture, and negative pressure closed drainage. After treatment, all 38 patients finished the surgery successfully, with an average operation time of 55 min (35-70 min) and an average hospital stay of 24 h to 72 h. All patients recovered well after surgery, without occurrence of postoperative complications like hydrops under incision, wound reinfection, intestinal fistula, postoperative pain, recurrence, and death, indicating well postoperative recovery. The follow-up period continued for 3 to 36 months.

Conclusion: Methylene blue guidance combined with closed negative pressure drainage and debridement to completely remove the mesh is the key to the treatment of mesh infection. Its satisfactory therapeutic effect and convenience prove its worth to be popularized in hospitals at all levels.

Key words: inguinal hernia; chronic infection; artificial mesh; sinus tract

1. Introduction

Inguinal hernia is one of the most common diseases in general surgery. Lichtenstein's concept of gained popularity because of its advantages of tension-free inguinal hernia repair has since less trauma and low recurrence rate, after which tension-free hernia repair has become the accepted standard surgical treatment for inguinal hernia worldwide. Tension-free herniorrhaphy with mesh implantation has been shown to reduce the recurrence rate of inguinal hernia surgery by more than 50% compared with traditional tension sutures (Alaedeen DI. et al., 2007). As polypropylene and other synthetic materials are widely used in inguinal hernia repair, the postoperative complications associated with the application of mesh have gradually increased, and the reports of serious complications associated with mesh such as mesh rejection and mesh

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infection have gradually increased. The results of studies on mesh infection rates vary widely (Aguilar B. et al., 2010), ranging from 0.001% to 10.0% (Eriksen J.R. et al., 2007; Hawn M.T. et al., 2010). Cobb et al. (Cobb W.S. et al., 2009) reported that the incidence of mesh infection after open inguinal hernia mesh repair ranged from 6% to 10%. Postoperative mesh-related infection, although rare, is one of the most difficult to handle (Hawn M.T. et al., 2010). Complete removal of mesh during debridement has become the major means in treatment of mesh infection. However how to completely remove the mesh is also one of the difficulties in treatment. Because, unlike traditional hernia suture repair, the treatment involving mesh infection is costly, time-consuming, often ineffective in antibiotic treatment and requires multiple surgeries, while the hernia tends to recur, affecting the patient's quality of life and work ability, showing that mesh infection worth
our hernia surgeons' attention. In this article, we retrospectively analyzed our experience in the management of mesh infection after this type of hernia repair, which is reported as follows.

From January 2015 to June 2019, 38 patients with mesh infection after inguinal hernia repair were admitted to the Department of Vascular Thyroid Hernia and Abdominal Wall Surgery of Guangdong General Hospital, of whom all were male, aged 24 to 86 years old, with an average age of (63.34 ± 18.84) years. The mesh infection occurred 1-8 years after inguinal hernia repair, with an average time of (1.97 ± 2.14) years. All patients with infection were repaired with polypropylene mesh or plug. The main surgical methods were plug filling and repairing, hernia ring filling with tension-free hernia repair and Prilling hernia device tension-free hernia repair. The clinical manifestation of infection was chronic open wound and chronic sinus after local dressing change and antibiotic treatment. The patient had no chronic cough, constipation, dysuria or other complications, and no lumbar anesthesia contradiction.

2. Method

1. Surgical procedure: methylene blue guidance combined with negative pressure drainage and debridement under spinal anesthesia.

2. Method of debridement (Figures 1-7): first, mix 2 mL of methylene blue in 8 mL of normal saline (along the infected sinus tract, inject methylene blue and dye the mesh to increase the possibility of removing the mesh at one time), and inject the mixture with pressure through the sinus ostium to ensure that methylene blue can infiltrate to all infected foci; cut the skin along the original surgical incision; under the instruction of methylene blue staining, use an electric knife to free the tissues around the sinus tract, remove all the methylene blue stained tissues, and completely remove the sinus tract and mesh; after mesh removal, local tissue technique was used to free the fascia tissue around the wound as much as possible to reduce the tension of the incision.

3. Management of wounds: all patients were treated with repeated irrigation with a large amount of iodophor, hydrogen peroxide, and normal saline for 3 times; a 22-gauge latex negative pressure ball was placed at the bottom of the wound for drainage; the wound was closed by primary fullthickness suturation using 2-0 Prolene suture.

4. Postoperative management: patients were given postoperative oral cephalosporin antibiotics for 3 days, regular postoperative dressing changes and close observation of wound changes; if drainage fluid was less than 5ml/d, the drainage tube can be removed; the stiches was routinely removed 2 weeks after operation and if superficial infection on wound still existed, local dressing change could be prolonged; the postoperative follow-up was mainly through outpatient review and telephone calling.

5. Outcome measures: All patients were followed up for 3-36 months after operation. The recovery condition, hospital stay, hospitalization cost difference and postoperative infection recurrence were analyzed and evaluated.

3. Results

All patients (n = 38) finished the surgery successfully, with an average operation time of 55 min and the hospital stay from 24 to72 h. The patients were discharged carrying the drainage tube after the operation and returned to the outpatient to remove the tube 7 days later. They were all followed-up for 3 ~ 36 months. All patients had grade A wound healing, without perioperative death. None had complications such as incision effusion, wound infection, intestinal fistula, postoperative pain and recurrence after operation.

Table 1. **Data on the assessment of the degree of wound healing**

	Cases	Percentage (%)
A	38	100%
B	0	0%
C	0	0%

4. Conclusion

Once mesh infection occurs after inguinal hernia repair, the treatment would be very challenging. It led to increased pain, prolonging hospital stay, and worsened prognosis, making it one of the more serious complications after tension-free hernia repair. During the hernia repair, extensive surgery, implantation of large foreign bodies and the following severe inflammatory reaction increase the risk of infection (Arnaud J. et al., 1977). The implantation of mesh enjoyed varied comments. Some scholars believe that the use of patch for hernia repair may increase the chance of infection (White T.J. et al., 1998). And some other scholars hold different belief that the use of mesh does not increase the wound infection (Grant A.M. et al., 2002). However, the wound infection, when occurs, is more serious and the treatment is more difficult for patients who use the patch during repair. Many factors contribute to mesh infection, such as patient's weight, presence of diabetes, type of hernia, operation time, and whether emergency surgery is performed. Besides mesh implantation itself, the microenvironment formed during surgery, such as excessive surgical dissection, excessive use of electrotome, the existence of invalid wound cavity or invalid mesh cavity due to mesh crimping, excessive use of sutures and rough edges of fixed mesh would all increase the chance of mesh infection. At the time of surgery, incautious hemostasis i and improper drainage could also lead to infection.

Mesh infection can occur at any stage after surgery, with early manifestations of redness, pain, and exudation at the surgical site, and systemic symptoms of high fever, chills, and sepsis. For delayed deep mesh infection, sinus tract would be formed, which is a blind tract that extends deep into the tissue and is mainly related to persistent chronic inflammation and mesh infection. Hernia repair surgery is a sterile procedure, and the incidence of infection is low (about 1%) regardless of the application of artificial mesh (Delikoukos S. et al., 2007). Swenson BR et al. conducted a retrospective study including 506 cases of hernia (abdominal wall hernia and incisional hernia) after mesh repair, and in the study 42 cases were finally diagnosed with mesh infection (8.3%) (Shulman A.G. et al., 1992). Especially for infection occurring after a long time of mesh implantation, a dense fibrous capsule has been formed around the mesh, which would prevent antibiotics from acting locally (Johanet H. et al., 2011).

In this study, the average retention time of mesh in the body was (1.97 ± 2.14) years, accompanied by local acute inflammation and fever and other acute systemic discomfort. Otherwise more patients had symptoms and signs of chronic, persistent and recurrent infection, even sinus tract formed in a few cases. The earliest patients suffering postoperative complications had fever, pain, wound dehiscence, incision redness and swelling, ulceration in 1 week after operation, and chronic sinus tract was formed after wound opening, dressing change and antibiotic treatment were given. Statistical data on sinus formation after inguinal hernia repair have not been reported, but there are serious complications such as enterocutaneous fistula and bladder injury due to mesh placement problems. In this case, the formation of sinus tract was considered to be related to the following factors: (1) the mesh could achieve tension-free repair, but at the same time it was also a foreign body, which was an innate risk of infection (Ayoade F. et al., 2017). (2) Superficial infection occurred at the surgical site in very early time, which was not properly managed and there may have been false healing, leading to the continued existence of inflammation. (3) The infection spread downward, which could invade the mesh, leading to the chronicity of the infection (Gillion J.F. & Palot JP., 2012) and the mesh was found to shrink and wrap the pus during debridement. In such cases of deep mesh infection, the surgical methods mainly included plug-filling repair, hernia ring filling with tension-free hernia repair and Prilling hernia device tension-free hernia repair. The plug and plain plate were placed in the preperitoneal space and fixed with the hernia ring so that the mesh was located very deep inside. In this group, the longest delayed infection lasted about 8 years, and ordinary silk thread was found to fix the mesh and suture tissue during surgical debridement. There were small abscesses at the line node, and silk thread was not excluded as the source of infection. We use Prolene suture with strong resistance to infection when we perform primary suture. In all hernia repairs, the mesh is fixed with absorbable suture, so as to reduce the risk of infection induced by saturation.

In treatment of mesh infection, removal of the mesh is the only viable method (Swenson B.R. et al., 2008). To reduce the risk of recurrence of infection and serious complications, conservative surgical m

ethods such as abscess drainage, sinus resection, and partial mesh removal can cause recurrence of infection. The mesh should therefore be completely removed. How to completely remove the mesh? Methylene blue guidance was used in our stduy. Methylene blue is an important tissue binding colorant, which has been widely used in clinical diagnosis and treatment. For example, in head, neck and thyroid surgery, sentinel lymph node biopsy and anastomotic integrity test after gastrointestinal surgery, it is used to explore whether the sinus tract and fistula communicate with bladder, small intestine and rectum. Methylene blue can play important roles in positioning, guidance and many other functions. During the sinus resection, we recommend the use of mixture of 2ml methylene blue with 8ml normal saline, which can not only mark tissue and guide surgery, ensuring the complete resection of sinus tract during the operation, but also avoid excessive damage to normal tissue. If the infected patch is partially exposed and removed during the first surgery, a new sinus tract would form after surgery, for which multiple surgeries are often required to remove the residual patches. Therefore, the application of methylene blue with pressure injection into the sinus tract can clarify the scope of the patch. In order to define the extent of mesh to be removed, we use methylene blue with pressure injection into sinus, and then remove all methylene blue stained tissue and the mesh and apply repeated irrigation of iodophor, hydrogen peroxide and normal saline on wound. This procedure is usually difficult because the mesh is often tightly adhered to the tissue and the surgical area bear severe exudation. Therefore, a closed drainage tube should be placed before closure to reduce the risk of infection due to effusion at the surgical site. Placing the negative pressure drainage tube can benefit the observation of postoperative effusion or bleeding firstly, so as to timely draw out the effusion and reduce the probability of infection. In addition, negative pressure drainage can reduce the dead space formation, prevent displacement of mesh and promote adhesion. After mesh removal, due to adhesion and scar formation, most patients did not experience hernia recurrence. For our group of 18 patients, local abdominal wall defect occurred after complete mesh removal, and biological mesh repair was performed. No hernia recurrence was obsereved.

The key to successful treatment is that during the operation, the sinus tract should be completely removed to the root along the methylene blue mark, leaving no dead space. The mesh and suture head that may be left should be completely cleaned, in case of suspicious foreign body left in. The wound should be irrigated repeatedly with a large amount of normal saline and hydrogen peroxide, the incision should be closed with absorbable suture, and drainage should be placed accurately.

In summary, tension-free hernia repair surgery, with its unique advantages and the wider application of mesh, is more and more prevailing in the treatment of inguinal hernia. In the meantime, mesh infection also gradually attracted the attention of surgeons. Hernia surgeons should continuously explore and accumulate experience, and master relevant knowledge and treatment skills of postoperative infection and sinus formation due to artificial mesh implantation. In this study, under the methylene blue staining mark, complete resection of sinus tract and removal of residual mesh and suture was achieved. Besides, strict aseptic operation rule and proper postoperative drainage also contribute to the satisfactory treatment effect, indicating that these procedures are worthy of being widely popularized in hospitals at all levels.

Figure 1: **After skin preparation and draping, locate the sinus ostium**

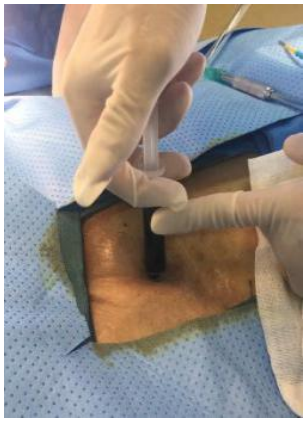

Figure 2: **First take 10 mL of methylene blue; along the infected sinus tract, inject methylene blue with into the sinus ostium.**

Figure 3: **After incision, under the guidance of methylene blue staining, electrotome should be used to free the tissues around the sinus tract, and silk knot residue scattered below the incision could be seen and removed.**

Figure 4: **The mesh (polypropylene mesh) is pyknotic with pus visible inside as we continue to separate the methylene blue stained sinus tract. The mesh would be closely adhered to the surrounding tissues. The ultrasonic scalpel and electrotome could be used to free the mesh fromsurrounding adhesions, and to completely remove it.**

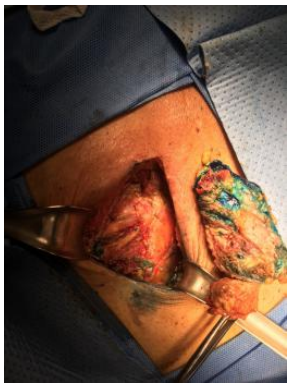

Figure 5: **Local abdominal wall defects can be repaired with biological mesh and multipoint fixation with absorbable sutures.**

Figure 6: **Remove the methylene blue stained tissue and the mesh could be taken out completely.**

Figures 7: **There is local abdominal wall defect, which can be repaired with biological mesh and fixed with absorbable suture in multiple points.**

Figure 8: **Iodophor, hydrogen peroxide and normal saline were used for repeated wound irrigation.**

The incision was closed in layers. A negative pressure drainage tube should be left at the bottom of the wound and punched out at the upper edge of the incision, externally connected with a negative pressure drainage.

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