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Original Research Article

A Retrospective Observational Study to Evaluate the Mesh Related Infections in A Tertiary Care Facility

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Conflict of interest: Nil

Abstract

Aim: The aim of this study to analysis of mesh related infections in a tertiary care centre

Methods: A retrospective observational study was conducted in the Department of General Surgery, MGM Medical College Kishanganj, Bihar, India from July 2019 to July 2020. All cases that underwent ventral and groin hernia surgeries and reported with mesh infections in the Department of General Surgery were included in the study. Demographics like age, sex and factors associated with mesh infection like BMI, comorbidities, time of presentation, tobacco consumption, ASA grade, type of hernia, type of hernia repair done were taken from medical records of the patients and their association with mesh infections were analysed.

Results: In our study, 20 cases of mesh infection were recorded out of 600 hernia surgeries (230 laparoscopic repairs and 370 open repairs). Total incidence of mesh infection reported was 20/600=3.33%). Incidence of infection in open repair was 6/370=1.62% and Lap repair showed incidence of 14/230=6.08%)

In this study, 70% of patients with mesh infection had a history of tobacco consumption, i.e. out of the 20 patients, 15 patients consumed tobacco, and 5 patients had no history of tobacco consumption. 65% patients had comorbidities. HbA1c of all diabetic patients was >16 is note worthy, emphasizing the fact that tight control of blood sugars is vital to prevent mesh infection. Out of 20 cases, 7 cases took less than 100minutes to be performed, and 13 cases took more than 100mins to be performed. The time duration of open surgery was 94+/-21.17mins and in patients who eventually had mesh infection were118.0+/- 20mins. Duration of surgery in patients who underwent laparoscopic surgery was 111.50+/-13mins, and in patients with mesh infection post, the laparoscopic repair was 133.45+/-30mins. 11 patients were of ASA grade 3 who developed mesh infection, and 9 patients were ASA grade 2 i.e 55% patients were ok ASA grade 3. In our study, 17 patients underwent mesh explantation, i.e. complete removal of the mesh, the infected sinus, and the surrounding infected tissue, followed by proper drainage of the surgical site. 1 patient was managed conservatively with an antibiotic wash, and parenteral antibiotics and 2 patients were tried to manage conservatively but later underwent mesh explantation

Conclusion: In our study incidence was more common after laparoscopic surgeries because there was a lapse in the sterilization process of the laparoscopic instruments, which was rectified with timely culture sensitivity tests and stringent sterilization process.

Keywords: Laparoscopic Surgeries, Mesh Explantation, Infection

Introduction:

Over 300,000 ventral hernia repairs are performed annually in the United States[1]. A majority of ventral hernias are repaired using mesh, with synthetic mesh being the most common choice[2]. Synthetic mesh has been well demonstrated to significantly reduce the hernia recurrence rate in ventral hernia repairs[3,4]. However, synthetic mesh is susceptible to becoming infected in both clean and contaminated repairs, resulting in the need for additional procedures to remove the infected mesh and repair a now larger hernia defect[5,6]. This adds additional costs due to extra procedures and a longer duration of stay in the hospital. The development and use of biologic mesh has been identified as an alternative to synthetic mesh for reducing infections. Biologic mesh has been used in contaminated cases to resist infection, thereby reducing the morbidity of post-operative wound infection and the need for additional procedures, which may justify the high cost of the mesh itself[6,7]. In today's environment, biologic mesh is primarily used in patients with class 3 (contaminated) and class 4 (dirty) wounds[7]. Its use in class 1 (clean) and class 2 (clean- contaminated) wounds has not been well studied. Its efficacy has been debated in the recent medical literature with some studies finding that biologic mesh is associated with higher recurrence rates than synthetic mesh and others finding similar performance between the two techniques[7-8]. Patient comorbidities have been reported to contribute to a higher risk of postoperative infection and complications including higher recurrence rates[10]. A diagnosis of chronic obstructive pulmonary disease (COPD), diabetes mellitus, and obesity have been shown to leave patients at higher risk to postoperative complications[11]. The association between high body mass index (BMI) and ventral hernias, as a result of increased stress on the abdominal wall, has also been well demonstrated[12]. Further, a history of smoking, prior ventral hernia repairs, and subsequent infections following repair have also been shown to contribute to complications[6,11].

Material and methods

A retrospective descriptive study was conducted in the Department of General Surgery, MGM Medical College Kishanganj, Bihar, India from July 2019 to July 2020.

Methodology

All cases that underwent ventral and groin hernia surgeries and reported with mesh infections in the Department of General Surgery were included in the study. Files with incomplete and inappropriate data needed for the study were excluded from the study. All primary hernia repairs were done on an elective basis, and antibiotics are given as per the protocol of our hospital. All cases of mesh infection during the study period (n=20) were analysed. Demographics like age, sex and factors associated with mesh infection like BMI, comorbidities, time of presentation, tobacco consumption, ASA grade, type of hernia, type of hernia repair done were taken from medical records of the patients and their association with mesh

infections were analysed. Results were tabulated in the form of mean, standard deviations and percentages.

Results

In this retrospective study, we reviewed the incidence of mesh infection after hernioplasty over the last two years and estimated the incidence of mesh infection and the associated risk factors among the included patients. In our study, 20 cases of mesh infection were recorded out of 600 hernia surgeries (230 laparoscopic repairs and 370 open repairs). Total incidence of mesh infection reported was 20/600=3.33%). Incidence of infection in open repair was 6/370=1.62% and Lap repair showed incidence of 14/230=6.08%).

Table 1: Number of cases with mesh infection after different type of repair

Type of repair	No. of patients (N=20)	%
Open repair		
Open PP	**4**	**20**
Lichtenstein	**2**	**10**
Lap repair		
IPOM	**4**	**20**
SCOLA	**4**	**20**
TEP and eTEP	**6**	**30**

Mesh infection was more common in males. Among ten patients, 15 were males and 5 female patients. About 15 patients were above the age of 40years, The Mean ± SD: 51.10±13.78.

In our study, mesh infection was more common in obese patients with a mean BMI of 32.70+/-1.78kg/m2. (Range 30.40-34.10).

The time of presentation after surgery was more after 5 months. The Mean ± SD being 5.55±3.27 (Range being 1-10 months).

In our study, 70% of patients with mesh infection had a history of tobacco consumption, i.e., out of the 20 patients, 15 patients consumed tobacco, and 5 patients had no history of tobacco consumption.

Table 2: Time of presentation of mesh infection after primary repair

Time in months	No. of patients	%
1-5	13	65
6-10	7	35

Table 3: Co-morbidities in cases of mesh infection

Co morbidities	No. of patients	%
Present	**13**	**65**
Absent	**7**	**35**

65% patients had comorbidities. HbA1c of all diabetic patients was >16 is noteworthy, emphasizing the fact that tight control of blood sugars is vital to prevent mesh infection. Out of 20 cases, 7 cases took less than 100minutes to be performed, and 13 cases took more than 100mins to be performed.

Table 4: Details of co morbidities in cases of mesh infection

Co morbidities	No. of patients=13	%
COPD	4	20
COPD+Type 2 DM	4	20
Type 2 DM	3	15
COPD +HTN	2	10

The time duration of open surgery was 94+/-21.17mins and in patients who eventually had mesh infection were118.0+/- 20mins. Duration of surgery in patients who underwent laparoscopic surgery was 111.50+/-13mins, and in patients with mesh infection post, the laparoscopic repair was 133.45+/-30mins.

The antibiotic protocol was followed in 19 cases out of 20. Antibiotic has used according to the protocol of our hospital; it was followed in 19 patients in the first surgery i.e., hernia repair surgery. Parenteral cephalosporin was used in 19 patients and amoxicillin-clavulanic acid in 1 patient. Antibiotic has repeated if the procedure was beyond 2 hours. After postoperative day 2, patients were switched over to oral antibiotics for three days. Likewise, during the second admission, i.e., when the patient was admitted with mesh infection, nine patients were given cephalosporin, and one patient was given Piperacillin tazobactam. Polypropylene mesh was used in 17patients, and the composite mesh was used in 3 patients who underwent IPOM. Polypropylene suture was used in all ten patients.

11 patients were of ASA grade 3 who developed mesh infection, and 9 patients were ASA grade 2 i.e 55% patients were ok ASA grade 3.

In our study, 17 patients underwent mesh explantation, i.e., complete removal of the mesh, the infected sinus, and the surrounding infected tissue, followed by proper drainage of the surgical site. 1 patient was managed conservatively with an antibiotic wash, and parenteral antibiotics and 2 patients were tried to manage conservatively but later underwent mesh explantation.

Discussion

Abdominal wall and inguinal hernia are common clinical scenarios in surgical practice. It is widely accepted that any sizable abdominal wall defect requires placement of mesh for reinforcement of repair and longer recurrence-free period[13]. SSI is defined as infections occurring within 30 days after surgery and affecting either the incision, organs, or body spaces at the site of the operation[14]. According to the definitions developed by the United States Centre for Disease Control (CDC), SSIs were categorized into 1. Superficial SSIs which involve the skin and subcutaneous tissue; 2. Deep SSIs which involve fascia and muscle layers; and 3. Organ/Space SSIs[15]. Mesh infection is a type of surgical site infection (SSI). Patient factors known to increase the risk of SSI and mesh infection are morbid obesity, tobacco abuse, chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), and immunosuppression[16]. The incidence of SSIs varies across surgical procedures, with a range of 0.1% to 50.4% reported in a systematic review by Korol et al.[17] Data showed that the laparoscopic inguinal hernia repair is associated with a lower incidence of mesh infection than an open procedure[18]. This might be due to the mesh being directly introduced through the port into the preperitoneal space during the laparoscopic repair. Thus, it has minimal contact with the surrounding skin and tissue. Adding on the mesh is placed in the

preperitoneal space, which is not close to the incision, in contrast to the open procedure. Nevertheless, thorough sterilization of laparoscopic instruments is more challenging, and the instruments are more prone to carry debris or organisms that can lead to infections[19].

Port site infection is a type of SSI but limited to laparoscopic surgery. Risk factors like comorbidities, obesity, and tobacco consumption apply to port site infections like in surgical site infection. Most of the surgical procedures done by laparoscopy belong to classes 1 and 2 wounds. It can be due to contamination from the endogenous source or exogenous source. A breach in the sterilization protocol of laparoscopic instruments is the most common cause of PSI[20]. Culture sensitivity reports from the laparoscopic instruments showed that there was a breach in the sterilization process of the instruments which was later rectified. Also, two procedures were performed after laparoscopic cholecystectomy, which can be a contributing factor for infection. This is in contrary to the world literature, which shows a higher incidence of mesh infection after open procedures. A study by Sauer land S et al. in 2011 showed 13% incidence of mesh infection after open surgery and 3% after laparoscopic surgery.[21] Another study by Brett L. Ecker et al. in 2016 showed 1.9% incidence of mesh infection after the open procedure and 0.9 % after laparoscopic procedures.[22]

Operative time is an independent risk factor for SSI that may be partially modifiable. The variables that can impact operating time are pre-operative planning, surgeon experience, operating room staff experience and access to equipment. The mechanism by which prolonged surgery can lead to infection is with in- creased operative time, incisions are exposed to the environment longer, thus increasing the risk of bacterial contamination. Also, longer operative time predisposes incisions to tissue desiccation that may also increase the probability of contamination[23,24]. Tissue concentrations of antibiotics will decrease as the procedure continues and may be inadequate if not re-administered during the surgical procedure[25,26]. However, in our centre, according to the antibiotic protocol, the antibiotic dose was repeated if the procedure took more than 120 minutes. In line with the world literature even our study showed mesh infections in procedures' that took more than 100 minutes to complete. The time duration of open surgery was 94+/-21.17mins and in patients who eventually had mesh infection were118.0+/- 20mins. Duration of surgery in patients who underwent laparoscopic surgery was 111.50+/-13mins, and in patients with mesh infection post, the laparoscopic repair was 133.45+/-30mins. Time duration to complete a laparoscopic procedure is more compared to open procedure. The cause of prolonged surgery could be that the procedure was performed by surgeons in the early phase of their learning curve. The risk for complications after hernia repair is increased among patients with comorbid conditions, such as obesity or diabetes[27]. Diabetes is a marker for other conditions like vascular changes and white blood cell dysfunction, which makes the patient prone to infection. Perioperative hyperglycaemia and subsequent immune suppression are affected by the complex contributions of factors in addition to the diabetic history of the patient, including physiologic stressors and exogenous glucose administration[28]. Studies by Rosemar A et al. and Lledo JB et al. have reported that patients with a BMI>25 kg/ m^2 had 50% higher risk of surgical site infection than those with normal body weight, thereby concluding that obesity is an independent risk factor for mesh infection following inguinal hernia repair[29,30]. In our study, 7 patients had Type 2 DM with Hba1C more than 16 which could be the

reason of mesh infection in these patients. Likewise, the body mass index of >30kg/m^2 was associated with mesh infection. Proper selection of the patient, ensuring good control of comorbid medical conditions will prevent mesh infections[31]. Patient age, ASA score, smoking and were found to be associated with the development of mesh infection. In a study conducted by Mavros et al.[32] showed that statistically significant risk factors were smoking (risk ratio [RR] = 1.36 [95% confidence interval (CI): 1.07, 1.73]; 1,171 hernioplasties), American Society of Anesthesiologists (ASA) score C3 (RR = 1.40 [1.15, 1.70]; 1,682 hernioplasties) and in obese patients (RR = 1.41 [0.94, 2.11]; 2,243 hernioplasties) and in patients operated on by a resident (in contrast to a consultant; RR = 1.18 [0.99, 1.40]; 982 hernioplasties). A study by Yang H et al. showed that obesity (46.5%), smoking (39.3%) and diabetes (8.9%) were significant risk factors for mesh infection.[33] Even our study showed an increased incidence of mesh infection in elderly patients, The Mean ± SD: 51.10±13.78years and in patients who consumed tobacco (70%), ASA grade >3 in 55% patients. The most common type of hernia was a paraumbilical hernia, and none of the patients had any superficial skin infection or enterocutaneous fistula at the time of surgery. There is also evidence that the development of mesh infection may be related to the type of material used[34-36]. Micro porous, multifilament mesh, and laminar mesh construction increase the surface area for bacterial adherence, impede leukocyte migration for bacterial clearance and leads to biofilm formation[37]. Pre-treatment of mesh with antimicrobial agents is not done in our setting. Sadava et al. established in animal models multifilament polyester mesh had more biofilm present on the infected mesh when compared to monofilament polypropylene mesh. In our study, polypropylene mesh was used in 17 patients and composite mesh in 3 patients who underwent IPOM repair. The antibiotic protocol was followed in 19 cases out of 20. Antibiotic has used according to the protocol of our hospital; it was followed in 19 patients in the first surgery i.e., hernia repair surgery. Parenteral cephalosporin was used in 19 patients and amoxicillin-clavulanic acid in 1 patient. Antibiotic has repeated if the procedure was beyond 2 hours. After postoperative day 2, patients were switched over to oral antibiotics for three days. Likewise, during the second admission, i.e., when the patient was admitted with mesh infection, nine patients were given cephalosporin, and one patient was given Piperacillin tazobactam. Polypropylene mesh was used in 17 patients, and the composite mesh was used in 3 patients who underwent IPOM. Polypropylene suture was used in all ten patients. Different guidelines exist to treat mesh infections but not very clear evidence in the literature to support a single optimal approach. While some studies prefer conservative management, some others prefer complete mesh removal. Large-pore monofilament mesh seems to be salvable in a majority of cases, particularly when placed in an extra peritoneal position, while micro porous, multifilament, and composite meshes typically require explantation[38].

Conclusion

In our study incidence was more common after laparoscopic surgeries because there was a lapse in the sterilization process of the laparoscopic instruments, which was rectified with timely culture sensitivity tests and stringent sterilization process. As ours is a teaching hospital, surgeries are performed by surgeons in the early phase of the learning curve, so it takes much longer to perform surgery than an experienced surgeon would take. Many parameters impact operating time, including pre- operative planning, surgeon experience, operating room staff experience, and access to equipment etc.,

which would lead prolonged exposure of the incision site to the environment and bacterial contamination.

References

1. Poulose BK, Shelton J, Phillips S, et al. Epidemiology and cost of ventral hernia repair: making the case for hernia research. Hernia. 2012;16(2):179–83.
2. Kokotovic D, Bisgaard T, Helgstrand F. Long-term recurrence and complications associated with elective incisional hernia repair. JAMA. 2016; 316(15):1575–82.
3. Luijendijk RW, Hop WC, van den Tol MP, et al. A comparison of suture repair with mesh repair for incisional hernia. N Engl J Med. 2000;343(6):392–8.
4. Nguyen MT, Berger RL, Hicks SC, et al. Comparison of outcomes of synthetic mesh vs suture repair of elective primary ventral herniorrhaphy: a systematic review and meta-analysis. JAMA Surg. 2014;149(5):415–21.
5. Deerenberg EB, Mulder IM, Grotenhuis N, et al. Experimental study on synthetic and biological mesh implantation in a contaminated environment. Br J Surg. 2012;99(12):1734–41.
6. Kissane NA, Itani KM. A decade of ventral incisional hernia repairs with biologic acellular dermal matrix: what have we learned? PlastReconstr Surg. 2012;130(5 Suppl 2):194S–202S.
7. Mulder IM, Deerenberg EB, Bemelman WA, et al. Infection susceptibility of crosslinked and non-crosslinked biological meshes in an experimental contaminated environment. Am J Surg. 2015;210(1):159–66.
8. Rosen MJ, Krpata DM, Ermlich B, et al. A 5-year clinical experience with single-staged repairs of infected and contaminated abdominal wall defects utilizing biologic mesh. Ann Surg. 2013;257(6):991–6.
9. Huntington CR, Cox TC, Blair LJ, et al. Biologic mesh in ventral hernia repair: Outcomes, recurrence, and charge analysis. Surgery. 2016;160(6):1517–27.
10. Shankar DA, Itani KMF, O'Brien WJ, et al. Factors associated with long-term outcomes of umbilical hernia repair. JAMA Surg. 2017;152(5):461–6.
11. Itani KM, Rosen M, Vargo D, et al. Prospective study of single-stage repair of contaminated hernias using a biologic porcine tissue matrix: the RICH Study. Surgery. 2012;152(3):498–505.
12. Pui CL, Tang ME, Annor AH, et al. Effect of repetitive loading on the mechanical properties of biological scaffold materials. J Am Coll Surg. 2012; 215(2):216–28.
13. Pauli EM, Rosen MJ. Open ventral hernia repair with component separation. Surgical Clinics. 2013 Oct 1;93(5):1111-33.
14. Hagihara M, Suwa M, Muramatsu Y, Kato Y, Yamagishi Y, Mikamo H, Ito Y. Preventing surgical-site infections after colorectal surgery. Journal of Infection and Chemotherapy. 2012 Jan 1;18(1):83-9.
15. Centers for Disease Control and Prevention. The Na- tional Healthcare Safety Network (NHSN) Manual: Patient Safety Component. Atlanta, GA: Division of Healthcare Quality Promotion. National Center for Emerging and Zoonotic Infectious Diseases. Available at: http://www.cdc. gov/nhsn/acute-care-hospital/index. html. (Last ac- cessed Feb 2015). 2017.
16. Breuing K, Butler CE, Ferzoco S. Franz m, Hultman CS, Kilbridge JF. Incisional ventral hernias: Review of the lit- erature and recommendations regarding the grading and technique of repair, J Surg. 2010;148(3):544-58.
17. Korol E, Johnston K, Waser N, Sifakis F, Jafri HS, Lo M, Kyaw MH. A systematic review of risk factors associated with surgical site infections among surgical

patients. PloS one. 2013 Dec 18;8(12): e83743.
18. McCormack K, Scott NW, Go PM, Ross S, Grant AM; EU Hernia Trialists Collaboration. Laparoscopic tech- niques versus open techniques for inguinal hernia re- pair. Cochrane Database Syst Rev. 2003;(1):CD001785.
19. Chowbey PK, Khullar R, Sharma A, Soni V, Baijal M, Garg N, Najma K. Laparoscopic management of infected mesh after laparoscopic inguinal hernia repair. Surgical La- paroscopy, Endoscopy & Percutaneous Techniques. 2015 Apr 1;25(2):125-8.
20. Chaudhuri S, Sarkar D, Mukerji R. Diagnosis and manage- ment of atypical mycobacterial infection after laparoscopic surgery. Indian Journal of Surgery. 2010 Dec 1;72(6):438-42.
21. Sauerland S, Walgenbach M, Habermalz B, Seiler CM, Mis- erez M. Laparoscopic versus open surgical techniques for ventral or incisional hernia repair. Cochrane database of systematic reviews. 2011(3).
22. Ecker BL, Kuo LE, Simmons KD, Fischer JP, Morris JB, Kelz RR. Laparoscopic versus open ventral hernia repair: longi- tudinal outcomes and cost analysis using statewide claims data. Surgical endoscopy. 2016 Mar 1;30(3):906-15.
23. Nguyen TJ, Costa MA, Vidar EN, Shahabi A, Peric M, Hernandez AM, Chan LS, Sener SF, Wong AK. Effect of immediate reconstruction on postmastectomy surgical site infection. Annals of surgery. 2012 Aug 1;256(2):326-33.
24. Haridas M, Malangoni MA. Predictive factors for surgi- cal site infection in general surgery. Surgery. 2008 Oct 1;144(4):496-503.
25. Alavi K, Sturrock PR, Sweeney WB, Maykel JA, Cervera- Servin JA, Tseng J, Cook EF. Asimple risk score for predict- ing surgical site infections in inflammatory bowel disease. Diseases of the colon & rectum. 2010 Nov 1;53(11):1480-6.
26. Sergeant G, Buffet W, Fieuws S, de Gheldere C, Vanclooster P. Incisional surgical site infections after colorectal surgery: time to appraise its true incidence. Acta Chirurgica Belgica. 2008 Jan 1;108(5):513-7.
27. Liang MK, Holihan JL, Itani K, Alawadi ZM, Gonzalez JR, Askenasy EP, Ballecer C, Chong HS, Goldblatt MI, Green- berg JA, Harvin JA. Ventral hernia management. Annals of surgery. 2017 Jan 1;265(1):80-9.
28. Lipshutz AK, Gropper MA. Perioperative glycemic control an evidence-based review. Anesthesiology: The Journal of the American Society of Anesthesiologists. 2009 Feb 1;110(2):408-21.
29. Rosemar A, Angerås U, Rosengren A, Nordin P. Effect of body mass index on groin hernia surgery. Annals of surgery. 2010 Aug 1;252(2):397-401.
30. Lledo JB, Quesada YS, Gavara IG, Urbaneja JV, Tatay FC, Di- ana SB, Pastor PG, Valdelomar RB, Pallardo JM. Infección de la prótesis en la reparaciónherniaria. Nuestraexperiencia en 5 años. Cirugía Española. 2009 Mar 1;85(3):158-64
31. Vagholkar K, Budhkar A. Combined tissue and mesh repair for midline incisional hernia. (A study of 15 cases). Journal of medical science and clinical research. 2014;2(8):1890-900.
32. Mavros MN, Athanasiou S, Alexiou VG, Mitsikostas PK, Peppas G, Falagas ME. Risk factors for mesh-related infec- tions after hernia repair surgery: a meta-analysis of cohort studies. World journal of surgery. 2011 Nov 1;35(11):2389.
33. Yang H, Xiong Y, Chen J, Shen Y. Study

of mesh infection management following inguinal hernioplasty with an analysis of risk factors: a 10-year experience. Hernia. 2020;24(2):301-305.
34. Brown CN, Finch JG. Which mesh for hernia repair? The Annals of The Royal College of Surgeons of England. 2010 May;92(4):272-8.
35. Engelsman AF, van Dam GM, van der Mei HC, Busscher HJ, Ploeg RJ. In vivo evaluation of bacterial infection involving morphologically different surgical meshes. Annals of surgery. 2010 Jan 1;251(1):133-7.
36. Engelsman AF, van der Mei HC, Busscher HJ, Ploeg RJ. Morphological aspects of surgical meshes as a risk factor for bacterial colonization. British journal of surgery. 2008 Aug;95(8):1051-9.
37. Perez-Koehler B, Bayon Y, Bellón JM. Mesh infection and hernia repair: a review. Surgical Infections. 2016 Apr 1;17(2):124-37.
38. Beffa LR, Warren JA. Management of mesh infection. In Textbook of Hernia. Springer, Cham, 2017:395-405.