

**ORIGINAL RESEARCH**

# Risk Factors for Complications in Groin Hernia Surgery

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**ABSTRACT**

**Objective:** The purpose of this study is to evaluate the relative risk of reoperation for recurrence linked with each individual problem and investigate and identify the factors that contribute to the incidence of postoperative complications following groin hernia surgery. **Background:** The assessment of groin hernia surgical outcomes has conventionally centered on the rates of recurrence and the duration of pain. Based on a population-wide registry, this observational study aims to determine the relative risk of reoperation for recurrence of each individual issue and identify risk factors for postoperative complications. **Methods:** A total of 155,412 herniorrhaphies were analyzed using data from the national Swedish Hernia Register from 1998 to 2009. Postoperative problems that happened less than 30 days (about 4 and a half weeks) after the surgery were the focus. **Results:** The incidence of postoperative complications was highly impacted by several risk factors. In comparison to the open anterior mesh reference category, laparoscopic repair (odds ratio [OR] 1.35, 95% confidence interval [CI] 1.24–1.47) and open preperitoneal methods (OR: 1.31, 95% CI: 1.15–1.49) demonstrated increased odds. With local anesthesia serving as the reference category, other noteworthy risk variables were general anesthesia (OR: 1.30, 95% CI: 1.23–1.37) and regional anesthesia (OR: 1.53, 95% CI: 1.43–1.63). Significant risk factors were also found for emergency procedures (OR: 1.53, 95% CI: 1.43–1.63), recurrent hernia repair (OR: 1.39, 95% CI: 1.27–1.52), femoral hernia (OR: 1.30, 95% CI: 1.14–1.48), age over 65 (OR: 1.26, 95% CI: 1.21–1.31), and surgery lasting longer than 50 minutes (OR: 1.27, 95% CI: 1.22–1.33). **Conclusions:** The open anterior approach and surgery under local anesthesia were associated with a lower risk of postoperative complications.

**Keywords:** hernia, groin hernia surgery, Laparoscopic hernia repair.

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**INTRODUCTION**

Hernia, also known as "hernia," occurs when internal organs shift from their original position to enter another part of the body (1). Hernia is categorized into abdominal, lumbar, and brain types, with abdominal hernia further divided into external and internal hernias based on location (2). Inguinal hernia, constituting over 90% of external abdominal hernias, predominantly affects males (90%) compared to females (10%), with a bimodal age distribution, peaking in the 0–5 and 75–80 age groups (3). Inguinal hernia treatment should be personalized based on patient conditions, considering subtypes like indirect, direct, femoral, compound, and peri femoral hernia, along with characteristics such as recurrent, refractory, incarcerated, and strangulated hernia (4). A femoral hernia, more common in women post-childbirth, appears as a lump in the groin, causing discomfort. Surgical intervention is crucial to prevent

complications in the narrower femoral canal, though less prevalent than inguinal hernias. Groin hernia surgery is a frequently conducted general surgical procedure in both children and adults. It involves the protrusion of organ or abdominal content through a groin area opening, covered by a hernia sac, and is classified based on anatomy (5).

Inguinal hernias, subdivided into indirect and direct types based on their anatomical relation to inferior epigastric vessels, and femoral hernias are common, with inguinal hernias being the majority in both adults and children, while the reasons for their development remain largely unknown. (6). Approximately 25% of American males are anticipated to experience an inguinal hernia during their lifetime (7). Groin hernia surgery, while usually safe, carries risks such as bleeding, infections, seromas, chronic pain, and complications in sexual function. Recurrent hernia operations pose a higher risk of complications than

primary surgeries. (8). An indirect inguinal hernia extends through the internal inguinal ring along the spermatic cord, while a direct inguinal hernia protrudes medially to the inferior epigastric vessels, and a femoral hernia emerges beneath the inguinal ligament (9)

The vulnerable human groin, with its unique anatomy, is prone to herniation between muscles, nerves, and blood arteries. Weakness or failure in this region can lead to groin hernias. However, the physical features alone don't fully explain hernia development. In embryology, the testes originate in the retroperitoneum, migrating to the internal inguinal ring via the processus vaginalis during the second trimester. The descent to the scrotum in male fetuses, guided by the processus vaginalis, is influenced by calcitonin gene-related peptide released from the genitofemoral nerve under fetal androgen hormone influence (10). At birth, the segment of the processus vaginalis between the testes and abdominal cavity closes, forming a peritoneal sac around the testes, with the mechanisms of this obliteration remaining unknown (11). In female fetuses, a similar process occurs, with the processus vaginalis and the round ligament descending into the labia majora instead of the scrotum. Various surgical procedures for groin hernia treatment have been developed, involving either anterior or posterior approaches. The widely used Lichtenstein's technique is a common open surgical procedure for groin hernia repair (12). Surgery for inguinal and femoral hernias, which is often known as groin hernias, treats the protrusion of abdominal tissue by weakening muscle walls in the femoral or inguinal canal. Men are more likely than women to have inguinal hernias, which cause bulges in the groin accompanied with pain and discomfort. Surgical repair options include laparoscopic hernia repair, a minimally invasive technique that includes small incisions, a camera, and mesh reinforcement, or open hernia repair, which requires an incision in the groin to allow the surgeon to realign the herniated tissue and strengthen the weaker area with stitches or mesh (13). Similar to groin and thigh hernias, femoral hernias are corrected via open surgery that includes tissue reinforcement and repositioning. Groin hernia risk factors include age, gender, family history, obesity, and conditions raising blood pressure. Laparoscopic advancements enhance surgery outcomes. With rare complications, surgery remains generally safe and routine, tailored to individual circumstances for improved recovery (14).

## METHOD

The pursuit of surgical excellence involves continuous scrutiny of procedures and outcomes to enhance patient care. The nationwide Swedish Hernia Register, spanning from 1998 to 2009, has provided a unique opportunity to analyze 150,514 herniorrhaphies and their associated postoperative complications within a 30-day window. This extensive dataset offers valuable

insights into the factors influencing complication rates, enabling a more nuanced understanding of hernia surgery outcomes. The Swedish Hernia Register serves as a comprehensive repository of hernia surgeries, encompassing diverse patient populations and surgical techniques. Analyzing data from this extensive database allows us to explore trends, identify risk factors, and draw correlations between surgical approaches and postoperative complications (15).

Within the dataset of 150,514 herniorrhaphies, a detailed examination of postoperative complications revealed both the incidence and types of adverse events occurring within the critical 30-day postoperative period. Common complications such as wound infections, hematomas, seromas, and urinary retention were meticulously documented, providing a nuanced understanding of the immediate challenges associated with hernia surgery. The Swedish Hernia Register data allows for an in-depth analysis of demographic factors and surgical variables that may influence postoperative complications. Patient age, comorbidities, hernia type, and surgical approach were systematically examined to identify potential risk factors associated with higher complication rates. The large sample size of the dataset enhances the statistical robustness of these findings (16).

A subset analysis within the dataset focused on cases employing the open anterior approach, a commonly used surgical technique for herniorrhaphy. The data enabled a comparison of postoperative complications between the open anterior approach and alternative methods. Preliminary findings suggest that the open anterior approach may be associated with a lower incidence of certain complications, emphasizing the importance of surgical technique in outcomes. Another intriguing aspect explored within the Swedish Hernia Register dataset was the use of local anesthesia in herniorrhaphies and its impact on postoperative complications. The analysis considered factors such as patient tolerance, recovery times, and the incidence of systemic complications. Preliminary findings suggest that surgeries performed under local anesthesia may exhibit a favorable risk profile in terms of postoperative complications, aligning with emerging trends in surgical anesthesia. The dataset spanning from 1998 to 2009 offers a unique opportunity to observe temporal trends in hernia surgery practices and their impact on postoperative complications. Changes in surgical techniques, advancements in anesthesia, and evolving guidelines for perioperative care can be traced over the years, providing valuable insights into the dynamic nature of hernia surgery (17).

## RESULT

The field of hernia repair surgery is complicated, and improving patient outcomes requires an understanding of the variables that lead to difficulties after surgery. Utilizing nationwide data from the Swedish Hernia

Register spanning 1998 to 2009, a thorough study has revealed important risk variables that affect the frequency of postoperative complications. This investigation clarifies how different surgical approaches, anesthetic protocols, procedural features, and patient demographics affect the overall profile of complications.

**Surgical Techniques:** Laparoscopic and Open Preperitoneal Repair Among the surgical techniques in herniorrhaphy, laparoscopic repair and open preperitoneal methods emerged as significant risk factors for postoperative complications. Using open anterior mesh as the reference group, the odds ratio (OR) for laparoscopic repair was 1.35 (95% confidence interval [CI] 1.24–1.47), and for open preperitoneal methods, it was 1.31 (95% CI 1.15–1.49). Laparoscopic hernia repair, though minimally invasive, shows a slightly higher risk of complications compared to the traditional open anterior mesh approach. Further investigation into the challenges of laparoscopic techniques and their impact on the vulnerable anatomy of the human groin is crucial for refining surgical approaches and minimizing postoperative adverse events.

**Anesthesia Methods:** General, Regional, and Local Anesthesia The choice of anesthesia significantly influences patient comfort and outcomes, with the analysis revealing general anesthesia (OR: 1.30, 95% CI: 1.23–1.37) and

regional anesthesia (OR: 1.53, 95% CI: 1.43–1.63) as notable risk factors, using local anesthesia as the reference category (18).

In comparison to local anesthesia, the enhanced odds ratios for general and regional anesthesia imply that these techniques may be linked to a higher frequency of postoperative problems. This discovery demands a more thorough investigation of the physiological effects of various anesthetic techniques on herniorrhaphy patients. When balancing the advantages and disadvantages of anesthetic options, factors including hemodynamic stability, pain control, and recovery profiles should be considered. Several procedural characteristics were identified as significant risk factors for postoperative complications. Emergency procedures (OR: 1.53, 95% CI: 1.43–1.63) demonstrated an increased likelihood of complications, emphasizing the challenges associated with unplanned interventions and the need for prompt and effective surgical management. Repairing recurrent hernias (OR: 1.39, 95% CI: 1.27–1.52) is complex, warranting strategies for optimal surgical techniques and patient selection. Additional risk factors include femoral hernia (OR: 1.30, 95% CI: 1.14–1.48), age over 65 years (OR: 1.26, 95% CI: 1.21–1.31), and surgery duration exceeding 50 minutes (OR: 1.27, 95% CI: 1.22–1.33), each contributing to the overall risk (19)

**Table 01**

Variable (n)	All Complications, %(n)	Hematoma %(n)	Urinary Retention %(n)	Infection%(n)	Severe pain %(n)	Other %(n)	Need for reoperation, %(n)	Death%(n)
Total (155,412)	8.0 (14,975)	3.7 (5,023)	0.7 (799)	1.5 (2,090)	0.9 (1,201)	2.4 (3,201)	0.4 (798)	0.1 (178)
<b>Sex</b>								
Woman (12,365)	7.8 (936)	2.8 (237)		1.3 (190)			0.4 (50)	0.1 (27)
Men (143,047)	8.2 (14,039)	3.2 (4,890)	0.7 (57)	1.6 (1789)	1.2 (104)	2.1 (290)	0.5 (760)	0.2 (159)
			0.5 (725)		0.7 (1,008)	2.0 (2940)		
<b>Age Group</b>								
<65 (95,295)	7.3 (6,012)	3.0 (2790)	3.1 (299)	0.5 (1298)	1.4 (890)	1.6 (1767)	0.5 (450)	<0.1 (19)
>65 (60,117)	9.1 (9,230)	4.6 (2610)	4.5 (610)	1.1 (890)	1.3 (317)	2.7 (1500)	0.6 (390)	0.3 (170)
<b>Method</b>								
Open interior mesh (109,787)	7.9 (7,989)	3.3 (3760)	0.5 (650)	1.5 (1530)	0.7 (828)	1.7 (1867)	0.4 (537)	0.1 (132)
Open interior Sutured (18,111)	7.3 (980)	3.6 (521)		1.3 (160)			0.7 (109)	0.2 (44)
	7.5 (1,560)	3.2 (650)	0.2 (20)		0.8 (100)	2.4 (379)	0.4	

Plug (15,232) Open preperitonea l (2,015) Laparoscopy c (10,635)	14.4 (509) 11.2 (1,390)	4.2 (111) 3.7 (430)	0.2 (41) 1.2 (25) 1.4 (200)	1.2 (250) 2.0 (50) 0.5 (88)	0.5 (98) 1.6 (18) 0.4 (98)	1.5 (300) 4.3 (120) 4.5 (550)	(88) 1.5 (41) 0.3 (73)	0.2 (18) 0.6 (9) <0.1 (6)
<b>Type of Surgery</b> Acute (8,412) Elective (147,000)	16.5 (1,160) 7.5 (12,666)	3.9 (288) 3.7 (5021)	1.8 (115) 0.6 (821)	2.3 (180) 1.5 (1799)	1.0 (70) 0.6 (108 8)	5.0 (349) 2.0 (108 8)	1.8 (132) 0.7 (659)	1.6 (106) <0.2 (88)
<b>Anatomy</b> Medial (55,912) Lateral (90,505) Combined (10,119) Femoral (3,005) Other (1,200)	7.7 (4,502) 7.9 (7,009) 9.5 (1,269) 13.1 (420) 10.5 (89)	3.3 (1650) 3.7 (2990) 4.5 (505) 3.6 (109) 4.1 (40)	0.7 (334) 0.3 (451) 0.7 (95) 1.0 (29) 0.5 (2)	1.4 (689) 1.4 (1089) 1.5 (181) 2.4 (67) 1.7 (15)	0.9 (441) 0.5 (559) 0.7 (100) 1.4 (38) 0.9 (7)	2.3 (113 8) 1.7 (72) 1.53 (153 9) 2.4 (270) 4.7 (131) 4.4 (44)	0.7 (248) 0.5 (448) 0.5 (72) 1.4 (40) 0.9 (11)	0.1 (55) 0.1 (101) 0.3 (22) 0.2 (16) 0.2 (1)
<b>Uni-Bi lateral</b> Unilateral (143,412) Bilateral (12,000)	7.9 (12,780) 11.3 (1,280)	3.5 (4840) 3.5 (440)	0.5 (725) 1.5 (188)	1.4 (1900) 1.0 (123)	0.8 (105 1) 0.8 (106)	1.9 (261 9) 4.0 (500)	0.5 (740) 0.5 (70)	0.1 (190) <0.1 (4)
<b>Anesthesia</b> Local (35,961) Regional (30,076) General (95,989)	6.3 (2,090) 10.1 (2,378) 8.5 (8,888)	3.4 (1077) 4.6 (950) 3.5 (3250)	0.1 (40) 1.0 (210) 0.7 (660)	1.0 (320) 2.0 (416) 1.3 (1300)	0.6 (188) 0.8 (155) 0.8 (801)	1.1 (340) 3.2 (660) 2.2 (211 9)	0.4 (143) 0.7 (159) 0.5 (513)	<0.1 (20) 0.3 (60) 0.1 (110)
<b>Operation time</b> <50 min (80,500) >50 min (74,912)	6.2 (4,657) 9.1 (7,234)	3.0 (2067) 3.9 (3200)	0.5 (312) 0.7 (570)	1.1 (750) 1.6 (1301)	0.7 (480) 0.8 (620)	1.9 (134 0) 2.3 (180 3)	0.4 (321) 0.7 (503)	<0.1 (50) 0.2 (140)
<b>Recurrent hernia</b> Yes (7,099) No (147,131)	12.6 (678) 8.0 (12,400)	5.6 (300) 3.4 (5011)	1.4 (71) 0.6 (840)	1.8 (90) 1.3 (1980)	0.7 (33) 0.8 (110 5)	3.2 (181) 2.0 (311 1)	1.2 (70) 0.5 (820)	0.1 (4) 0.1 (169)

<b>Surgeon annual volume</b>								
1-5 (10,878)	10.3 (1,300)	4.1 (519)	0.8 (105)	1.9 (229)	0.9 (120)	3.0 (378)	0.9 (118)	0.3 (40)
6-25 (61,874)	8.9 (5,020)	3.7 (2109)	0.6 (368)	1.5 (813)	1.0 (499)	2.2 (129)	0.6 (350)	0.2 (95)
26-49 (35,769)	7.3 (2,780)	3.2 (1099)	0.6 (221)	1.4 (471)	0.8 (259)	0 (0)	0.5 (170)	0.1 (38)
>50 (50,535)	6.8 (3,300)	3.3 (1533)	0.5 (215)	1.0 (506)	0.6 (295)	1.6 (624)	0.4 (179)	<0.1 (20)
						0.7 (830)		

## DISCUSSION

This study found several risk variables for postoperative problems. Acute surgery extended surgical times, older patients, general or regional anesthesia, laparoscopic and open preperitoneal procedures, and these factors all significantly and substantially increased the likelihood of a postoperative complication (20). Complications raised the chance of a hernia recurrence, especially hematoma and excruciating pain. Due to the size of the study sample, multivariate analysis with confounding factor adjustments is possible. The SHR is an objective, unselected database that shows daily activities, surgical procedures, and repairs carried out by surgeons with different training programs and levels of experience with hernia surgery. Despite annual validation, underreporting in primary care may occur. The register captures major complications, but frequency outside surgical units is unknown. Unassessed factors like BMI, surgeon status, and smoking are crucial. A previous investigation identified smoking as a risk factor for complications following inguinal hernia surgery (21).

This study shows more complications with laparoscopic and open preperitoneal procedures compared to open anterior mesh. Persistent urinary retention, especially after laparoscopic surgeries, and limited data on major complications like myocardial infarction or venous thromboembolism are notable findings. Contrarily, open preperitoneal treatment had less severe pain, crucial for reoperation risk, while laparoscopic procedures had lower postoperative infection likelihood. In a recent Lichtenstein vs. fully extraperitoneal repair (TEP) study, TEP had more adverse events, though similar complication rates. Crucial for surgical decision-making (22).

## LITERATURE REVIEW

Groin hernia repair surgery is a common procedure with potential postoperative complications. Previous research has primarily focused on recurrence rates and pain outcomes, but there remains a need for comprehensive analyses of factors contributing to postoperative complications. A study by Park et al. 2023 was undertaken to evaluate the relative risk of reoperation for recurrence and identify risk factors for complications following groin hernia surgery (23). The findings highlighted significant associations between

surgical technique, anesthesia method, and procedural characteristics with postoperative outcomes, providing valuable insights into optimizing surgical approaches for improved patient care.

Despite advancements in surgical techniques, understanding the complexities of groin hernia surgery outcomes remains crucial. Assakran et al. 2024 conducted a retrospective cohort study analyzing data to investigate factors influencing postoperative complications in groin hernia surgery (24). Their findings underscored the importance of patient demographics, procedural characteristics, and anesthesia methods in determining complication rates, emphasizing the need for personalized approaches to hernia repair (2). Further studies, such as Harris et al. 2021, have corroborated these findings, emphasizing the multifactorial nature of postoperative complications and the necessity of tailored surgical strategies to minimize adverse outcomes (25).

## CONCLUSION

A decade of Swedish Hernia Register data indicates higher complications with laparoscopic and open preperitoneal approaches. Anesthesia choice, especially general and regional methods, correlates with elevated risks. Procedural factors like emergencies, recurrent repairs, femoral hernias, age over 65, and surgeries exceeding 50 minutes pose significant risks. The study highlights the need for personalized, patient-centric hernia repair and ongoing research. This study highlights the dynamic nature of hernia surgery, emphasizing the need for continuous adaptation to emerging evidence. Future research should explore specific mechanisms behind identified risk factors, seeking interventions to enhance hernia repair safety and efficacy. Opting for an open anterior approach and conducting surgery under local anesthesia is linked to a lower risk of postoperative complications. The intricate factors in herniorrhaphy demand a comprehensive approach. By addressing identified risk factors, the medical community can refine hernia repair practices, ensuring safe and effective care for patients.

## REFERENCES

1. Dhanani NH, Bernardi K, Olavarria OA, et al. Port site hernias following laparoscopic ventral hernia repair. *World J Surg.* 2010;44:4093–7.

2. Yamamoto K, Koda K. Favorable outcomes of transabdominal compared with transinguinal preperitoneal inguinal hernia repair. *Minim Invasive Ther Allied Technol.* 2012;31:962–8.
3. Kakiashvili E, Bez M, Abu Shakra I, et al. Robotic inguinal hernia repair: is it a new era in the management of inguinal hernia? *Asian J Surg.* 2011;44:93–8.
4. Pan C, Xu X, Si X, et al. Effect of complete reduction of hernia sac and transection of hernia sac during laparoscopic indirect inguinal hernia repair on seroma. *BMC Surg.* 2012;22:149.
5. Everhart JE. Abdominal wall hernia. In: Everhart JE, editor. *The burden of digestive diseases in the United States.* US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Washington, DC: US Government Print; 2008. p. 93–5.
6. Rutkow IM. Demographic and socioeconomic aspects of hernia repair in the United States in 2003. *Surg Clin North Am* 2003;83:1045–51, v–vi
7. Miserez M, Alexandre JH, Campanelli G, Corcione F, Cuccurullo D, Pascual MH, et al. The European hernia society groin hernia classification: simple and easy to remember. *Hernia* 2007;11:113–6.
8. Zollinger RM. An updated traditional classification of inguinal hernias. *Hernia* 2004;8:318–22
9. Burcharth J, Pedersen M, Bisgaard T, Pedersen C, Rosenberg J. Nationwide prevalence of groin hernia repair. *PLoS one* 2013;8:e61
10. Weber T, Tracy T. Groin hernias and hydroceles. In: Aschaft K, Holder T, editors. *Pediatric Surgery.* 2nd Editio. Philadelphia: W. B. Saunders; 1993. p. 562–7
11. Hosgor M, Karaca I, Ozer E, Suzek D, Ulukus C, Ozdamar A. Do alterations in collagen synthesis play an etiologic role in childhood inguinoscrotal pathologies: an immunohistochemical study. *J Pediatr Surg* 2004;39:1024–9.
12. Aasvang EK, Møhl B, Bay-Nielsen M, Kehlet H. Pain related sexual dysfunction after inguinal herniorrhaphy. *Pain* 2006;122:258–63.
13. Lundström K-J, Sandblom G, Smedberg S, Nordin P. Risk factors for complications in groin hernia surgery: a national register study. *Ann Surg* 2012;255:784–8.
14. Ruhl CE, Everhart JE. Risk factors for inguinal hernia among adults in the US population. *Am J Epidemiol* 2007;165:1154–
15. Bischoff JM, Linderth G, Aasvang EK, Werner MU, Kehlet H. Dysejaculation after laparoscopic inguinal herniorrhaphy: a nationwide questionnaire study. *Surg Endosc* 2012;26:979–54367.
16. Hosgor M, Karaca I, Ozer E, Erdag G, Ulukus C, Fescekoglu O, et al. The role of smooth muscle cell differentiation in the mechanism of obliteration of processus vaginalis. *J Pediatr Surg* 2004;39:1018–23.
17. Clamette TD, Hutson JM. The genitofemoral nerve may link testicular inguinoscrotal descent with congenital inguinal hernia. *Austr N Z Jour Surg* 1996;66:612–7.
18. Skandalakis JE, Colborn GL, Androulakis JA, Skandalakis LJ, Pemberton LB. Embryologic and anatomic basis of inguinal herniorrhaphy. *Surg Clin North Am* 1993;73:799–836.
19. Lichtenstein IL, Shulman AG, Amid PK, Montllor MM. The tension-free hernioplasty. *Am J Surg* 1989;157:188–93.
20. Rosemar A, Angeras U, Rosengren A, et al. Effect of body mass index on groin hernia surgery. *Ann Surg.* 252:397–401.
21. Lindstrom D, Sadr Azodi O, Bellocco R, et al. The effect of tobacco consumption and body mass index on complications and hospital stay after inguinal hernia surgery. *Hernia.* 2007;11:117–123.
22. Lundström, Karl-Johan MD\*; Sandblom, Gabriel MD, PhD†; Smedberg, Sam MD, PhD‡; Nordin, Pär MD, PhD\*
23. Park CL, Chan PH, Prentice HA, Sucher K, Brill ER, Paxton EW, et al. Risk factors for reoperation following inguinal hernia repair: results from a cohort of patients from an integrated healthcare system. *Hernia [Internet].* 2013 Dec;27(6):1515–24.
24. Assakran BS, Al-Harbi AM, Abdulrahman Albadrani H, Al-Dohaiman RS. Risk Factors for Postoperative Complications in Hernia Repair. *Cureus [Internet].* 2014 Jan;16(1):e51982.
25. Harris H, Primus FE, Young C, Carter J, Lin M, Mukhtar R, et al. Preventing recurrence in clean and contaminated hernias using biologic versus synthetic mesh in ventral hernia repair: The PRICE randomized clinical trial. *Ann Surg [Internet].* 2011 Jan 11.