



## Analysis of Predictors of Complications and Mortality in Postoperative Ventral Hernia Surgery

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**Abstract:** The article describes the most frequent complications of operations performed for postoperative ventral hernias. The data of recent studies to identify the main predictors of local complications, recurrences and mortality are presented. The authors tried to make a comparative analysis of different methods of ventral hernia repair, both open and minimally invasive. The main points in the preparation of patients for reconstructive surgery, compliance with which can significantly reduce the number of unsatisfactory results, are highlighted.

**Key words:** ventral hernias, prosthetics, synthetic mesh, wound complications.

**Introduction.** Awareness of surgical outcomes is an important component of the quality of abdominal wall hernia repair. The American Hernia Society has developed a collaborative quality programme (AHSQC) to continuously improve the quality of disease-based abdominal wall hernia repair. This initiative allows for the inclusion of demographic, postoperative follow-up and patient-centred data. Thus, abdominal wall hernia is a common problem in surgical practice with numerous plasticity options both in terms of technique and mesh selection. Monitoring outcomes through collaborations such as the AHSQC will be increasingly important for surgeons who routinely perform these procedures.

Lindmark et al. (2018) attempted to identify risk factors for surgical complications in ventral hernia repair, need for intensive care unit and re-hospitalisation after ventral hernia repair. The hypothesis was that there is an association between increased complication rate after ventral hernia repair and specific factors including hernia size, BMI > 35, concomitant bowel surgery, ASA grade, age, gender and method of hernia repair. Data from a hernia database with prospectively entered data on 408 patients operated for ventral hernia between 2007 and 2014 at two Swedish university hospitals were analysed. A 3-month follow-up of complications, need for intensive care and re-hospitalisation was performed by reviewing medical records. Eighty-one of 408 patients (20%) had a reported complication. Fifty-eight (14%) were classified as Clavien grades I-III A. Twenty-one of 408 (5%) patients had an infection. Seven out of 42 (17%) patients with onlay plasty had severe complications

(Clavien>IIIa), namely two anastomosis failures, one cutaneous fistula, three cases of skin necrosis and two infections. Four of them underwent major concomitant bowel surgery followed by hernia repair in the same session. Three of these were colorectal procedures and one gastric sleeve resection operation was associated with conversion of a gastric bypass anastomosis. Large hernia size was associated with an increased risk of early complication. Kendall's tau test analysis revealed a proportional association between hernia size and modified Clavien outcome class ( $p < 0.001$ ). Morbid obesity, ASA class, method, hernia recurrence, age and concomitant bowel surgery were not statistically significant predictors of adverse events. Assessment of hernia size is important in the preoperative evaluation of patients with ventral hernia to consider the risk of postoperative complications.

The choice between surgical and conservative treatment of non-obstructive ventral hernia in high-risk patients is often a clinical challenge. KhorgamiZ, et al. (2019) evaluated national series of open and laparoscopic ventral hernia repair (VHR) and assessed predictors of mortality after elective VHR. They analysed data from 2008-2014 from the Healthcare Cost and Utilisation Project, a nationwide inpatient sample. All patients with a primary diagnosis of abdominal wall hernia were included in the study. Groin, femoral, or diaphragmatic hernias were excluded. Patients were divided into planned and emergency operations. Factors associated with mortality after elective VHR were analysed. A total of 103635 patients were examined, including 14787 (14.3%) umbilical, 63685 (61.5%) postoperative and 25163 (24.3%) other ventral hernias. Operative interventions included 59993 (57.9%) planned and 43642 (42.1%) emergency VHRs. 21.3% of planned VHRs were laparoscopic compared with 13% in emergency cases ( $P < 0.001$ ). Mesh was used in 52642 (87.7%) elective surgeries compared with 27734 (63.5%) emergencies ( $P < 0.001$ ). The median length of hospitalisation was 2 days in the laparoscopic group and 3 days in the open group ( $P < 0.001$ ). Mortality was 0.2% ( $n=135$ ) in the planned group and 0.6% ( $n=269$ ) in the emergency group ( $P < 0.001$ ). In the planned group, mortality rates were similar for laparoscopic and open VHR (0.2%), whereas in the emergency group it was lower for laparoscopic VHR (0.4% vs. 0.6%,  $P=0.028$ ). The authors concluded that VHR has low mortality, especially when performed laparoscopically. In patients undergoing elective surgery, older age and some comorbidities are predictors of mortality. These include congestive heart failure, pulmonary circulatory disorders, coagulopathy, liver disease, metastatic cancer, neurological disorders and paralysis. Conservative treatment should be considered for these high-risk subgroups in the context of the overall clinical picture.

FergusonDH, et al. (2021) attempted to investigate factors associated with complication rates of component separation[3]. More than 350000 ventral hernia surgeries are performed annually and more often abdominal wall component separation is used for this purpose. A national inpatient sample (2005-2014) was used to identify all patients diagnosed with VH of the ninth revision of the International Classification of Diseases who underwent open VH repair using a pedicled flap or with graft advancement. All cases included in this study were elective and were not associated with additional procedures. Demographic, clinical and hospital characteristics were extracted. Independent predictors of complications and outcomes were determined using multivariable regression analysis. Component partitioning was performed in 4346 patients. The mean age was 56 years; the majority were female (55%) and white (80%). Most patients (73%) operated in an urban teaching hospital; mesh was used in 80% of cases and 11% were smokers. The most frequent comorbidities were arterial hypertension (50%), obesity (26%), diabetes mellitus (23%), CHD (11%) and COPD (8%). Half of the patients (50%) had private insurance and 35% had Medicare. Mortality was 0.5%; median length of stay was 5 days. The overall complication rate was 25% (wound 11%, intraoperative 5%, infectious 11%, and pulmonary 8%). The use of mesh was associated with a lower incidence of wound complications (10% vs 15%,  $P=0.001$ ). The authors stated that after separation of abdominal wall

components, complications were greater in patients with COPD, obesity, diabetes mellitus and low income.

BastaMN, et al. (2016) used the American College of Surgeons National Surgical Quality Improvement Programme to create a model for mortality risk stratification according to VHR[2]. Patients who underwent open VHR were selected from the American College of Surgeons National Surgical Quality Improvement Programme databases. A total of 55760 patients were included with a mortality rate of 1.34%. Predictors of mortality included the following: functional status (odds ratio [OR]=2.87), liver disease (OR=3.61), malnutrition (OR=1.43), age older than 65 years (OR=2.39), American Society of Anaesthesiologists 4 or higher (OR=2.90), systemic inflammation (OR=1.99), and contamination (OR=2.15). Patients were divided into low risk (mortality 0.33%), intermediate risk (mortality 1.86%), high risk (mortality 8.76%) and extreme risk (mortality 34.2%) groups. Unplanned reoperations and medical complications increased in the high-risk groups. The model demonstrated high discriminatory power with a C-statistic value of 0.86. The BastaMN study provides an accurate model for predicting mortality risk specific to open VHR. The strongest predictors were liver disease, functional status and advanced age. This tool can inform clinical decision making to reduce complications.

There are studies showing that preoperative functional health status influences the outcome of ventral hernia repair. ReynoldsD, et al. (2013) identified predictors of adverse outcomes in functionally dependent patients undergoing ventral hernia repair[7]. The authors reviewed all patients in the ACS NSQIP database who underwent elective ventral hernia repair from 2005 to 2009. Thirty-day outcomes included mortality, wounds, pulmonary complications, venous thromboembolism, development of sepsis/shock, renal failure/insufficiency, and cardiovascular causes. Risk factors were assessed using multivariate analysis. This identified 75865 patients who underwent elective ventral hernia repair, of whom 1144 were classified as functionally dependent. Overall, severe soreness was observed in 211 (18.4%) patients. There was no statistically significant difference in any measurable outcome between laparoscopic and open hernia repair. Increasing age was found to be an independent predictor of mortality with an odds ratio of 1.63 (95% confidence interval (CI) 1.27-2.12) for every 10 years of age above the mean. Ascites and preoperative renal failure were also identified as independent predictors of mortality with odds ratios of 9.7 and 11.5, respectively. Preoperative pulmonary compromise was shown to be an independent predictor of both mortality and serious morbidity with odds ratios of 4.1 and 2.47, respectively. The authors conclude that elective ventral hernia repair in a functionally dependent patient population has significant morbidity and mortality. Advanced age, ascites, preoperative renal failure, and preoperative pulmonary failure were independent predictors of 30-day mortality. Conservative treatment should be seriously considered in the presence of these risk factors.

Recurrence after ventral hernia repair (VHR) remains a significant complication. WarrenJA, et al. (2017) sought to identify technical aspects of VHR associated with recurrence[8]. To assess recurrence patterns and failure mechanisms after open mesh ventral hernia repair, patients who underwent open midline VHR between 2006 and 2013 (n=261) were retrospectively evaluated. Patients with recurrence (group 1, n=48) were compared with patients without recurrence (group 2, n=213). Smoking, diabetes and body mass index did not differ between groups. Most patients in group 1 had procedures with clean contamination, contamination, or contamination (43.8 vs 27.7%; P=0.021). Surgical site infections (52.1 vs 32.9%; P=0.020) and surgical site infections (43.8 vs 15.5%; P<0.001) were more common in group 1. Recurrences were associated with central mesh failure (CMF) (39.6%), midline recurrence after plasty with biological or bioabsorbable mesh (18.8%), upper midline (16.7%), lateral (16.7%) and after mesh explantation (12.5%). Lightweight polypropylene (LWPP)

accounted for the majority of CMF (78.9%). The recurrence rate was higher if the medial fascia could not be closed.

Recurrences with medium density polypropylene mesh (MWPP) were lower than with bio(P<0.001), bioabsorbable (P=0.006) and lightweight polypropylene mesh (P=0.046). Fixation, component separation technique, and mesh position did not differ between groups. Wound complications were associated with subsequent recurrence, whereas medium polypropylene was associated with a lower overall risk of recurrence and, in particular, CMF.

Preoperative surgical risk assessment continues to be a critical component of clinical decision making. BastaMN, et al. (2016) propose the American College of Surgeons (ACS) universal risk calculator, which estimates risk for multiple outcomes based on individual risk profiles. While this represents a huge step towards improving outcomes, studies have reported inaccuracies among certain patient populations. This study aimed to evaluate the prognostic accuracy of the ACS risk calculator in patients undergoing open ventral hernia repair (VHR). A review of patients who underwent open isolated VHR between 01.07.2007 and 01.07.2014 by a single surgeon was performed. Risk factors and outcomes were collected as defined by the National Surgical Quality Improvement Project. Thirty-day outcomes included major complications, venous thromboembolism, somatic morbidity, surgical site infection (SSI), unplanned reoperation, mortality and length of hospital stay (LOS). Patient profiles were entered into a surgical risk calculator and risk predictions for specific outcomes were recorded. Prognostic accuracy was assessed using the Briere scale. 142 patients who underwent open VHR were included. ACS predictions were accurate for cardiac complications (Briere=0.02), venous thromboembolism (Briere=0.08), reoperation (Briere=0.10) and mortality (Briere=0.01). Notably, underestimated outcomes included IOHF (Briere=0.14), major complications (Briere=0.30) and any complications (Briere=0.34). Discrimination ranged from very precise (mortality, AUC=0.99) to indiscriminate (SSI, AUC=0.57). Predicted LOS was 3 times shorter than observed (2.4 vs 7.4 days, P<0.001). Finishing the study, the authors found that the ACS surgical risk calculator accurately predicted medical complications, reoperation, and 30-day mortality. However, IOHV, major complications, and length of treatment were significantly underestimated. These data suggest that additional considerations are needed to more accurately estimate complications after open VHR.

The use of standard surgical interventions like alloplasty in the onlay position does not solve the problem of early postoperative complications: seroma detachment, mesh migration, adhesions, high rate of hernia recurrence, etc. At the same time, hernia repair with local tissues creates the problem of increased intra-abdominal pressure and late complications in the form of hernia recurrence. These problems are aggravated in patients with complications of hernia impingement. It is also necessary to take into account the presence of ligature fistulas in the area of hernia gates, as well as unresolved problems of the choice of tactics for the treatment of complications of alloplasty (migration of mesh, paraprostatic hernia, infection, etc.). The increase in postoperative intra-abdominal pressure leads to multi-organ failure, then abdominal compartment syndrome (ACS), and even death. The correct surgical technique can be determined on the basis of preoperative MSCT, which can determine the relationship between the volume of the hernia sac and the abdominal cavity, determining the degree of disproportion, which is related to the postoperative value of abdominal pressure. Currently, there is no agreement on the surgical approach for such giant postoperative abdominal wall hernias. And to achieve better mesh augmentation, the component separation technique (CST) may be a suitable solution, but with a significant risk of complications and recurrence. A truly successful giant hernia hernioplasty requires effective bridging or augmentation to prevent recurrence with an acceptable risk of complications.

Thus, abdominal wall hernia is a common problem in surgical practice with numerous treatment options both in terms of technique and mesh selection. Attempts to use synthetic prostheses for



impingement hernia are reflected in the literature by contradictory data. The possibilities of prosthesis implantation in the setting of acute and chronic infection, often present in patients with impingement hernia, are not fully defined.

The choice of access and method of giant ventral hernia repair is still an unsolved problem of modern surgery. It is necessary not only to restore the normal anatomic structure of the anterior abdominal wall, but also to minimise early postoperative complications and recurrence rate. The option of separation of the anterior abdominal wall during plasty of large ventral hernias is still a subject of discussion. Often the choice of the method of intervention depends on the individual preferences of the operating surgeon. A clinical and anatomical substantiation of the choice of the method of surgical intervention, a detailed analysis of the immediate results of treatment of patients with giant ventral hernias is required.

**Conclusions:** Based on the above, there is a need to improve the algorithm for choosing the method of surgical intervention and determining clear indications for prosthetic plasty.

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