

Review

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Risk factors for perioperative complications in inguinal hernia repair – a systematic review

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Abstract: The current literature suggests that perioperative complications occur in 8%–10% of all inguinal hernia repairs. However, the clinical relevance of these complications is currently unknown. In our review, based on 571,445 hernia repairs reported in 39 publications, we identified the following potential risk factors: patient age, ASA score, diabetes, smoking, mode of admission (emergency vs. elective surgery), surgery in low resource settings, type of anesthesia, and (in men) bilateral and sliding hernias. The most commonly reported complications are bleeding (0.9%), wound infection (0.5%), and pulmonary and cardiovascular complications (0.2%). In 3.9% of the included publications, a reliable grading of the reported complications according to Clavien-Dindo classification was possible. Using this classification retrospectively, we could show that, in patients with complications, these are clinically relevant for about 22% of these patients (Clavien-Dindo grade \geq IIIa). About 78% of all patients suffered from complications needing only minor (meaning mostly medical) intervention (Clavien-Dindo grade $<$ III). Especially with regard to the low incidence of complications in inguinal hernia repair, future studies should use the Clavien-Dindo classification to achieve better comparability between studies, thus enabling better correlation with potential risk factors.

Keywords: Clavien-Dindo classification; inguinal hernia surgery.

Introduction

For men, there is a lifelong risk of contracting an inguinal or femoral hernia of 27%–43%. For women, there is a risk of 3%–6% [1]. Throughout the world, about 20 million inguinal hernia repairs are performed every year. Thus, inguinal hernia repair is one of the most frequently performed surgeries worldwide. Although three professional societies have developed guidelines for the treatment of inguinal hernia [2–4], no consensus has been reached with regard to a standardized therapy. Since the introduction of mesh augmentation in hernia repair, a multitude of techniques have developed, each with respective inherent risk factors. In this context, complications are defined as an uncommon course of disease accompanied by particular symptoms. Complications may develop due to an underlying illness and/or due to the treatment of the disease. The severity of the complications may be classified using the seven-point Clavien-Dindo classification scale [5]. The scale is patient-oriented and uses the most important clinical consequences impacting the course of treatment. Most of the studies in this review do not use the classification.

An overview of complications occurring perioperatively in inguinal hernia repair might best be achieved using registry data. The Swedish Hernia Registry, for instance, reports an overall complication rate of about 8% [6]. This is in line with Polak and Nyhus [7]. However, there is still some ambiguity with regard to the actual incidences of specific complications. For instance, a newly published review reports incidence rates for wound infection after hernia surgery of 2.4%, which is about twice as high as the incidence rate published in the Swedish registry and almost 10 times higher than the reports of the German Herniamed Registry [6, 8, 9].

Light or severe complications are often not clearly defined. For instance, seromas are mostly regarded as low-grade, common complications, whereas intraoperative or postoperative bleeding of anticoagulated patients may lead to major complications, including death [10].

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Therefore, the aim of this systematic review is to offer an overview on potential risk factors with regard to the Clavien-Dindo classification.

Materials and methods

Laparoendoscopic hernia surgery was established in the early 1990s. Case reports and studies dating back to this time were not included in this review due to the general learning curve for those techniques. Only actual evidence on complication potential was considered here. We conducted a literature search as described in Figure 1. All publications reporting perioperative outcome in relation to the specified risk factors in elective and emergency inguinal hernia repair were included. All reports concerning only chronic groin pain, which is often classified as a postoperative complication, were excluded.

Overall, 39 reports were found to be relevant to the research question. Of these, 3 were randomized controlled trials [11–13], 5 were prospective studies [14–18], 4 were case reports [10, 19–21], 25 were retrospective (registry) studies [22–46], and 2 were meta-analyses [47, 48].

Risk factors were identified. In addition, incidence rates were analyzed for various types of complications in 17 of the studies [11, 13, 15, 16, 18–20, 22, 24, 26, 29, 32, 36–38, 44]; if possible, the complications reported in the included studies were graded with regard to the Clavien-Dindo classification. Not all complications summarized here were reported in all of the studies. In addition, the amount of complications ranged from 1 to more than 4000 in the respective studies. For better comparison between studies, a weighting had to be implemented. Therefore, to normalize all data, the number of each respective complication reported was divided by the number of all complications reported in the respective study. The thusly calculated ratios were summed up over for each respective complication for all studies the respective complication was reported in. For example, Hellspong et al. [32] reported 2657 bleedings and 4744 complications overall, giving a ratio of 0.56. Mayer et al. [37] reported 203 bleedings and 934 complications overall, giving a ratio of 0.22. The sum of both ratios is 0.78. This method was used for all complications mentioned in all 18 studies.

Results

Analysis of risk factors and overall complication rate

In 39 studies, data of 571,445 hernia repairs were evaluated. The following risk factors for perioperative complications in inguinal hernia were identified: patient age [37, 41], ASA score [37], diabetes [32], smoking [35, 36], mode of admission (emergency vs. elective surgery) [39, 45], surgery in low resource settings [48], type of anesthesia [25, 39], and (in men) bilateral hernia [33, 39] and sliding hernia [30, 39].

Overall, 16,482 (2.9%) perioperative complications were reported. Of these, 23 were deaths corresponding to Clavien-Dindo grade V (0.004%). In low resource settings, the risk of death increases to 0.49%, thus being about 100 times higher than in developed countries. In sub-Saharan Africa, the risk of death even reaches 2.5% [48].

Analysis of specific complications

For further analysis, only one publication each concerning data from the Swedish registry and Herniamed was used. Thus, using the same patient collective, more than once was avoided.

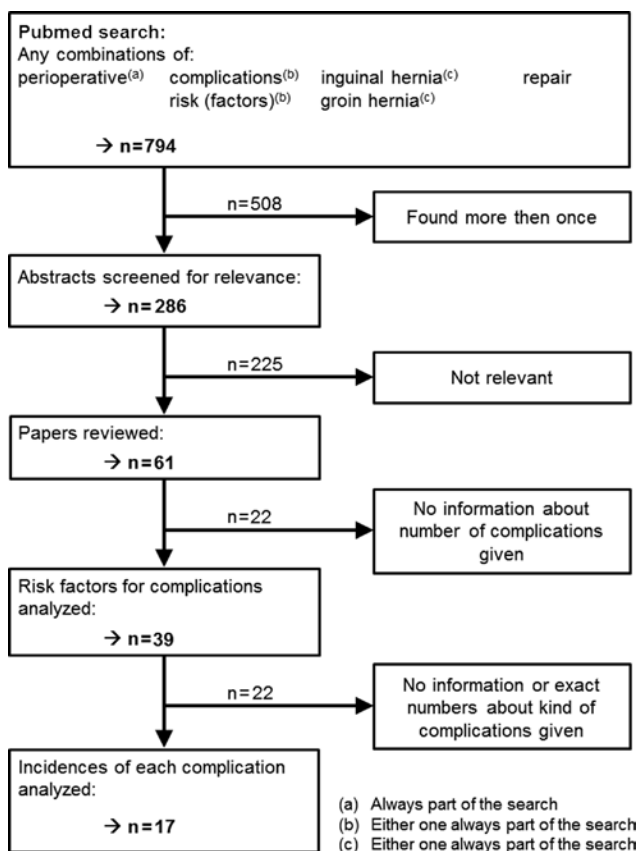


Figure 1: Flow chart of the literature search.

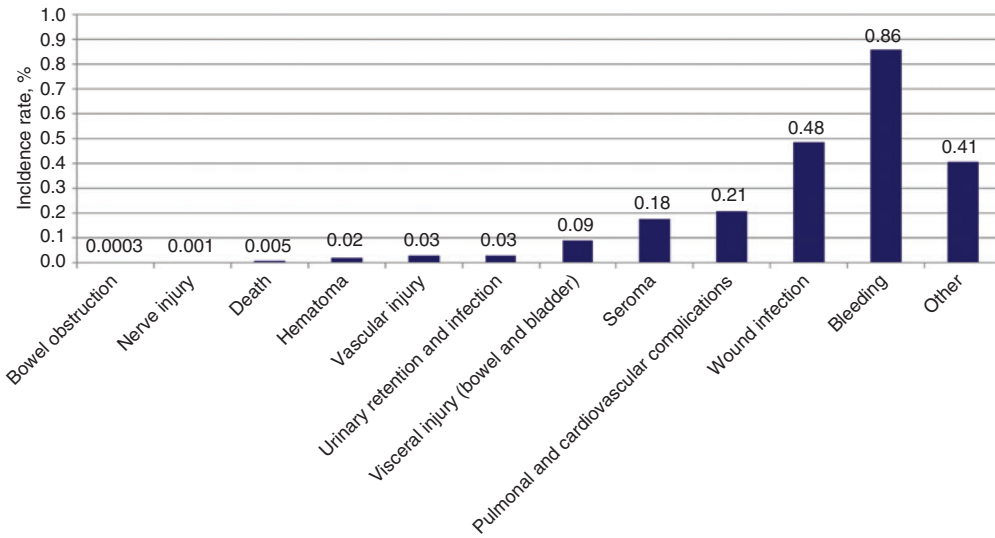


Figure 2: Distribution of 7985 reported incidences with regard to the type of complication.

More specific information on the actual type of complication was given only in 17 of 39 studies with 345,746 of 571,445 hernia repairs. Overall incidence rates for other complications range between 0.0003% (bowel obstruction) and 0.86% (bleeding). The most commonly reported complications were bleeding, wound infection, and pulmonary and cardiovascular complications (see Figure 2).

Grade V was already analyzed as mentioned above. Most reported incidences could be classified as Clavien-Dindo grades I and II (75%), indicating the need for only minor (mostly medical) intervention. Grade III, defined as requiring surgical, endoscopic, or radiological intervention, was needed in 21.5% of all cases. Only 0.2% of all reported complications were classified as life-threatening complications (grade IV).

Grading according to Clavien-Dindo classification

Of the 16,482 complications, 651 (3.9%) were reliably classifiable according to Clavien-Dindo (see Figure 3). Clinically relevant complications include only grades IIIa to IV. Therefore, grades I and II were analyzed collectively.

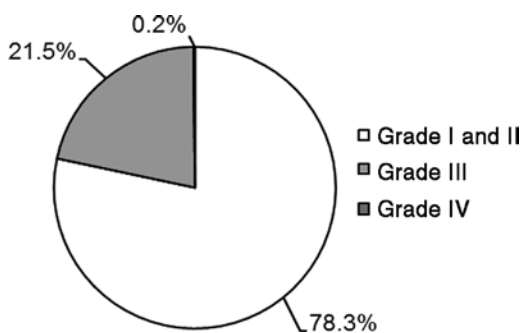


Figure 3: For 651 of 7985 reported incidences, Clavien-Dindo classification was possible. Depicted is the distribution of complications according to Clavien-Dindo classification.

Discussion

The risk of death as the most severe complication in inguinal hernia repair has an incidence of 0.004%, which is very low in developed countries. However, it may be up to 100 times higher in undeveloped countries. Incidence rates for specific perioperative complications are very low in our review (2.9% in this review and about 8% in the Swedish Hernia registry). We only regarded perioperative complications in this review. Therefore, we did not include chronic groin pain in our analysis, which is a commonly reported complication after inguinal hernia repair, explaining our relatively low overall complication rate. However, the aim of this review was not to evaluate the overall complication rate, as the focus was more on evaluating typical perioperative complications, calculating the potential impact of those complications on the patients' treatment, and identifying risk factors associated with the respective complications.

Our literature review shows that overall complication rates in inguinal hernia repair are low. However,

we could identify risk factors for perioperative complications. For example, according to Nilsson et al. [39], the most relevant risk factors for 30-day morbidity after hernia repair are localization of the hernia (femoral vs. inguinal), patient age, ASA score, mode of admission (emergency vs. elective surgery), and type of anesthesia. In the Swedish registry, emergency surgery was more frequent in women compared to men (17 vs. 5%). For women, femoral hernia had occurred in 23% (2670 of 11,623) of all cases, whereas femoral hernia occurred only in 1% (1324 of 128,944) of all surgeries in men. For men, bilateral and sliding hernias pose an increased risk for complications.

Patients > 60 years old with emergency surgery show a significantly higher risk for cardiovascular complications within the first 30 days after surgery. Incidence rates of cardiovascular complications in our review (0.21% of all complications) are in line with the data from the Swedish registry (0.3–2.3%). Our data suggest that pulmonary and cardiovascular complications are among the five most frequent perioperative complications.

Wound infection rate in low-risk environments are reported to be less than 5%. For patients with high comorbidity, the risk may rise to 8.7%. The most important risk factor for wound infection is bilateral surgery. Overall, there is some ambiguity in the data to that regard. For example, in the Swedish registry, 96% of all inguinal hernia repairs conducted in Sweden are documented. The registry data show that the postoperative infection rate is 1.2% in men and 1.5% in women. In the German Hernia-med Registry, infections occur in 0.2% of all laparoendoscopic cases and in 0.6% of all open repairs. However, in Sweden, only 5.6% of the patients receive antibiotic prophylaxis, whereas in Germany 70% of all patients scheduled for inguinal hernia repair receive antibiotics [49]. In our review, 0.5% of all reported complications concern wound infection, which is in line with the German Hernia-med Registry.

In the literature, complications after transabdominal preperitoneal (TAPP) repair range between 1.2% and 49% (median 11.4%). For totally extraperitoneal (TEP), the results are similar (1.3–50.3%; median 12.5%). Registry studies report lower complication rates for TAPP and TEP. The overall complication rate in the Hernia-med registry is higher for TAPP (5.4%) than for TEP (2.9%) contrary to the Swiss Hernia Registry (TAPP 1.7% vs. TEP 4.2%) [28]. The incidence rate for visceral complications (e.g. puncture of the bladder or bowel) after TEP or TAPP is very low (0.2% and 0.6%, respectively). Bladder or bowel injury occurred in 0.3% (29 of 10,887) of all cases after TAPP and in 0.1% (7 of 6700) after TEP [9]. Irrespective of the surgery

technique, we observed an incidence rate for visceral injury in 0.1% of all cases.

Bleeding occurred more often in TEP than in TAPP (0.41% vs. 0.28) [50]. Including open repair, we detected a higher risk for bleeding of 0.9%. This observation is in line with published registry data [51].

Like every review, this review is limited due to incomplete reports in the publications and by missing definitions. For instance, we completely disregarded chronic groin pain in this review, because definition as well as the type of pain measurement are very heterogeneous. A newly published study evaluating pain measurement procedures after inguinal hernia repair [52] shows that 22 different definitions of pain were used in 48 studies. For the measurement of pain, 53 studies used 33 different procedures. Thus, developing reliable recommendations for preventive measures against chronic groin pain is very difficult.

By graduating the complications according to the Clavien-Dindo classification, we could quantify the amount of clinically relevant complications. Overall, the risk for complications in inguinal hernia repair is low (2.9–8%). If complications occur, then in 78% of all cases they are manageable by conservative means (Clavien-Dindo grades I and II). Conversely, postoperative intervention was needed in 22% of all classifiable cases (Clavien-Dindo grade \geq III). To our knowledge, routine documentation of complications based on the Clavien-Dindo classification is not performed outside of study settings. Especially with regard to the low incidence of complications in inguinal hernia repair, future studies should use the Clavien-Dindo classification to achieve better comparability between studies, thus enabling better correlation with potential risk factors.

Author Statement

Research funding: Authors state no funding involved. Conflict of interest: Authors state no conflict of interest. Informed consent: Informed consent is not applicable. Ethical approval: The conducted research is not related to either human or animal use.

Author Contributions

Dirk Weyhe: Conception of review study; analysis of literature; writing of the manuscript; revision of the manuscript; approval of the manuscript. Navid Tabriz: Analysis of literature; data retrieval; approval of classified data. Bianca Sahlmann: Analysis of literature; data retrieval; classification of collected data. Verena Uslar: Analysis of literature; data retrieval; data analysis; statistical analysis; writing of the manuscript; revision of the manuscript.

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Supplemental Material: The article (DOI: 10.1515/iss-2017-0008) offers reviewer assessments as supplementary material.

Reviewer Assessment

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Reviewers' Comments to Original Submission

Reviewer 1: anonymous

Jan 31, 2017

Reviewer Recommendation Term:	Accept
Overall Reviewer Manuscript Rating:	70
Custom Review Questions	Response
Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	4
Does the abstract clearly reflect the paper's content?	4
Do the keywords clearly reflect the paper's content?	2
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	4
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	4
Are units and terminology used correctly?	4
Is the number of cases adequate?	5 - High/Yes
Are the experimental methods/clinical studies adequate?	3
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	3
Please rate the practical significance.	5 - High/Yes
Please rate the accuracy of methods.	3
Please rate the statistical evaluation and quality control.	3
Please rate the appropriateness of the figures and tables.	4
Please rate the appropriateness of the references.	5 - High/Yes
Please evaluate the writing style and use of language.	5 - High/Yes
Please judge the overall scientific quality of the manuscript.	3
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

This is a well presented topic of significant clinical relevance. As the authors state - hernia repairs are one of the most frequent operations worldwide. It is of utmost significance to know the risk factors for perioperative complications in particular due to the fact that many inguinal/femoral hernia repairs are performed on an outpatient Basis. Evaluating a vast amount of studies the authors could finally identify 39 publications which were further evaluated. Well-known risk factors were identified and may help in the future to improve the perioperative data for inguinal hernia repair.

The study definitely has some limitations, which are not addressed in this review because the authors clearly state these limitations in the discussion of the data. The figures in the manuscript substantially improve the paper and are essential for the understanding. It seems justified to argue for a greater acceptance of the Clavien-Dindo classification to report perioperative complications in order to better compare different studies.

The key words should be ranked as follows and extended by: inguinal hernia surgery - perioperative complications - risk factors - Clavien-Dindo classification

That can be done by the publisher and does not require a revision by the authors.

Reviewer 2: Timm Franzke

Feb 09, 2017

Reviewer Recommendation Term:

Accept

Overall Reviewer Manuscript Rating:

N/A

Custom Review Questions**Response**

Is the subject area appropriate for you?	5 - High/Yes
Does the title clearly reflect the paper's content?	3
Does the abstract clearly reflect the paper's content?	3
Do the keywords clearly reflect the paper's content?	2
Does the introduction present the problem clearly?	4
Are the results/conclusions justified?	3
How comprehensive and up-to-date is the subject matter presented?	4
How adequate is the data presentation?	3
Are units and terminology used correctly?	4
Is the number of cases adequate?	4
Are the experimental methods/clinical studies adequate?	3
Is the length appropriate in relation to the content?	4
Does the reader get new insights from the article?	2
Please rate the practical significance.	4
Please rate the accuracy of methods.	3
Please rate the statistical evaluation and quality control.	2
Please rate the appropriateness of the figures and tables.	3
Please rate the appropriateness of the references.	4
Please evaluate the writing style and use of language.	4
Please judge the overall scientific quality of the manuscript.	3
Are you willing to review the revision of this manuscript?	Yes

Comments to Authors:

The work gives a good overview of the perioperative complications after operative interventions in inguinal hernias. The known risk factors have been confirmed. The authors found that the generally accepted Clavien-Dindo classification was only rarely used and thus a comparison is difficult. The authors advocate a consistent application of this classification in the future. Unfortunately, 2 major complications are not discussed in the area of hernia surgery, recurrence, and chronic pain. The authors justify this by the difficult identification of these complications. Unfortunately, it is not fully comprehensible how the authors come to their final statements. Furthermore, the differences between surgical procedures are not clearly discussed.