



RESEARCH ARTICLE

ACS NSQIP and hip fracture in the elderly. A mini review

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ABSTRACT

Introduction: Hip fractures occur commonly in the geriatric population and represent an important source of morbidity and mortality in the elderly population. The increasing incidence of hip fracture in this type of patients is due both to increased life expectancy and to the high prevalence of osteoporosis in the elderly. Hip fracture not only affects the health status of the individual patient, but it is responsible for an increased commitment of resources by the healthcare system. A preoperative tool predicting a potential postoperative complication can help to stratify the risk of each individual patient, to set the best diagnostic and therapeutic procedure. The National Surgical Quality Improvement Program (NSQIP) of the American College of Surgeons (ACS) has promoted the development of a surgical risk calculation system widespread throughout the world. A surgical risk calculation system was officially created in 2013 and it is available on the web, including twenty different variables such as factors related to the individual patient and the planned surgical procedures. This electronic calculator allows to obtain the percentage of risk of mortality, need for readmission and morbidity, and to estimate the duration of hospitalization.

Methods: We performed a search on the main database such as PubMed and Cochrane Library, using specific terms: i.e. "Hip surgery", "ACS NSQIP risk calculator", "proximal femur fracture" and "hip fracture". We reviewed all the articles relevant to our topic, performing a qualitative analysis of the data presented.

Results: We found 107 articles, only four were eligible for a full review. After a careful evaluation, only two studies fitted well with the purpose of our review. These two studies showed a good effectiveness of ACS NSQIP to predict postoperative mortality.

Conclusions: The ACS NSQIP risk calculator seems to be effective in predicting postoperative complications and in particular postoperative mortality after hip surgery, but we do not have enough data. In fact, we have only two studies regarding hip fractures in elderly patients (> 60 years). Further studies are necessary.

Keywords: ACS NSQIP risk score; hip surgery; geriatric population; proximal femur fracture.

Introduction

Hip fracture has become a worldwide major public health concern. They occur commonly in the elderly population and represent an important source of morbidity and mortality in the elderly population^[1] representing a global health problem. The number of hospitalizations for proximal femur fracture is continuously increasing, especially above the age of 75 (84.9% of cases)^[2]. Due to the increase in life expectancy of the world's population, an increase in the incidence of hip fractures is expected in the next few years^[3,4]. Hip fractures are associated with an increased risk of mortality amongst older adults, with a cumulative 30-day mortality rate between 5 and 10%^[5]. It has been shown that the incidence and costs of proximal femur fractures in the elderly in Italy are comparable to those relating to myocardial infarction^[6]. The direct costs associated with this condition are enormous since it requires a long period of hospitalization and subsequent rehabilitation. Furthermore, hip fracture is associated with the development of other negative consequences, such as disability, depression, and cardiovascular diseases, with additional costs for society and increased commitment of resources by the healthcare system. Options for treating hip fractures comprise conservative and operative treatment. Conservative treatment has many disadvantages, particularly prolonged immobility and high in-hospital complications^[7,8]. Early operative treatment has demonstrated to improve functional outcomes^[9], shortened length of stay^[10], reduced duration of pain^[11], decreased postoperative complications^[12], and lower mortality compared to conservative treatment^[13,14]. To identify the patients at greatest risk, preoperative predictors of mortality following hip fracture surgery have been studied extensively^[15-17]. Preoperative prognostics could be used to better inform patients and family on the consequences of the different treatment alternatives, leading to better shared decision-making. Furthermore, they can be very useful to perform the best clinical perioperative management of the patient. It is particularly relevant for frail

patients with a limited life expectancy, who face higher risk of mortality. Shared decision-making could be used to select a treatment that is optimal in terms of both clinical outcomes and patients' personal values^[18,19]. During this process, it is essential that decisions are supported by the best available evidence^[20]. The postoperative complications including myocardial infarction, venous thromboembolism, pneumonia, and delirium seemed to be the causes of high mortality^[21-24]. Many factors seem to be related to mortality rates such as age, sex, underlying disease, anesthesia technique, and ASA (American Society of Anesthesiology) physical status^[25-29]. Another factor of concern was the time to operation. It has been proved that delayed time to operation was associated with increased mortality^[12,13]. A preoperative tool that allows to predict a potential postoperative complication can help to stratify the risk of each patient, allowing to set the best diagnostic and therapeutic procedure, resulting in a better clinical outcome for the patient and a better use of the resources of the healthcare system. The National Surgical Quality Improvement Program (NSQIP) of the American College of Surgeons (ACS)^[30] has promoted the development of a surgical risk calculation system widespread throughout the world. The ACS-NSQIP was created after a review of databases and an analysis of postoperative patient data and possible complications, involving more than one million surgical patients treated in 393 hospitals in the United States of America. Initially imagined with the aim of reducing postoperative morbidity and mortality, a real surgical quality evaluation system was created. A surgical risk calculation system was officially created in 2013 and is available on the web: it consists of twenty different variables that include factors related to the individual patient and the planned surgical procedures^[31]. This electronic calculator allows to obtain the percentage of mortality risk, need for readmission and morbidity, and to estimate the duration of hospitalization^[32].

The ACS NSQIP Surgical Risk Calculator allows surgeons to easily enter 21 preoperative risk factors for a specific patient, such as specific age

group, sex, functional status, emergency case, ASA class, steroid use for chronic condition et al.

(<https://riskcalculator.facs.org/RiskCalculator/PatientInfo.jsp>). It could permit to the clinicians to receive a report of the customized, patient-specific risks of surgery, and specifically: death, any complication, pneumonia, heart problem, surgical site infection, bladder infection, blood clot, kidney failure. The Surgical Risk Calculator can be used for more than 1500 CPTs across all surgical subspecialties. Aim of this mini review is to analyze the current literature regarding the use of this risk calculator for elderly patients (≥ 60 years) undergoing surgery for proximal femur fractures.

Materials and methods.

The authors conducted a literature search of available articles regarding hip surgery and the use of ACS NSQIP risk calculator to predict postoperative mortality and morbidity in elderly population (> 60 years). We searched in MEDLINE and in the Cochrane Library, from 2013 until 2024. There were no language restrictions. Research studies were selected based on research topics such as: "hip fracture; hip surgery; ACS NSQIP risk score calculator; geriatric population; elderly

population; femur fracture; femur surgery". In this review, the inclusion criteria were as follows: (1) the article describes the use of ACS NSQIP risk calculator for predicting preoperative morbidity and mortality following hip fracture surgery in patients of 60 years or older, (2) the study reports on primary evidence, (3) the full-text document can be retrieved. The exclusion criteria were as follows: (1) pathological hip fractures, (2) population age below 60 years, (3) use of ACS NSQIP risk score for patients undergoing surgery of other skeletal district such as knee, foot, ankle, shoulder, arm, humerus, hand. These studies were analyzed according to the aim of the review. Most of them focused on analysis of risk factors in geriatric patients undergoing orthopedic surgery by analyzing the ACS NSQIP database, therefore not eligible for the aim of our review. 107 studies were identified through the literature search, four were retrieved for detailed assessment. The studies excluded were duplicate reports or regarding knee or humerus surgery or regarding risk tools assessment using ACS NSQIP database. Our final primary analysis included four studies. After careful analysis of the four studies selected, only two matched the objective of our review (Fig.1.0).

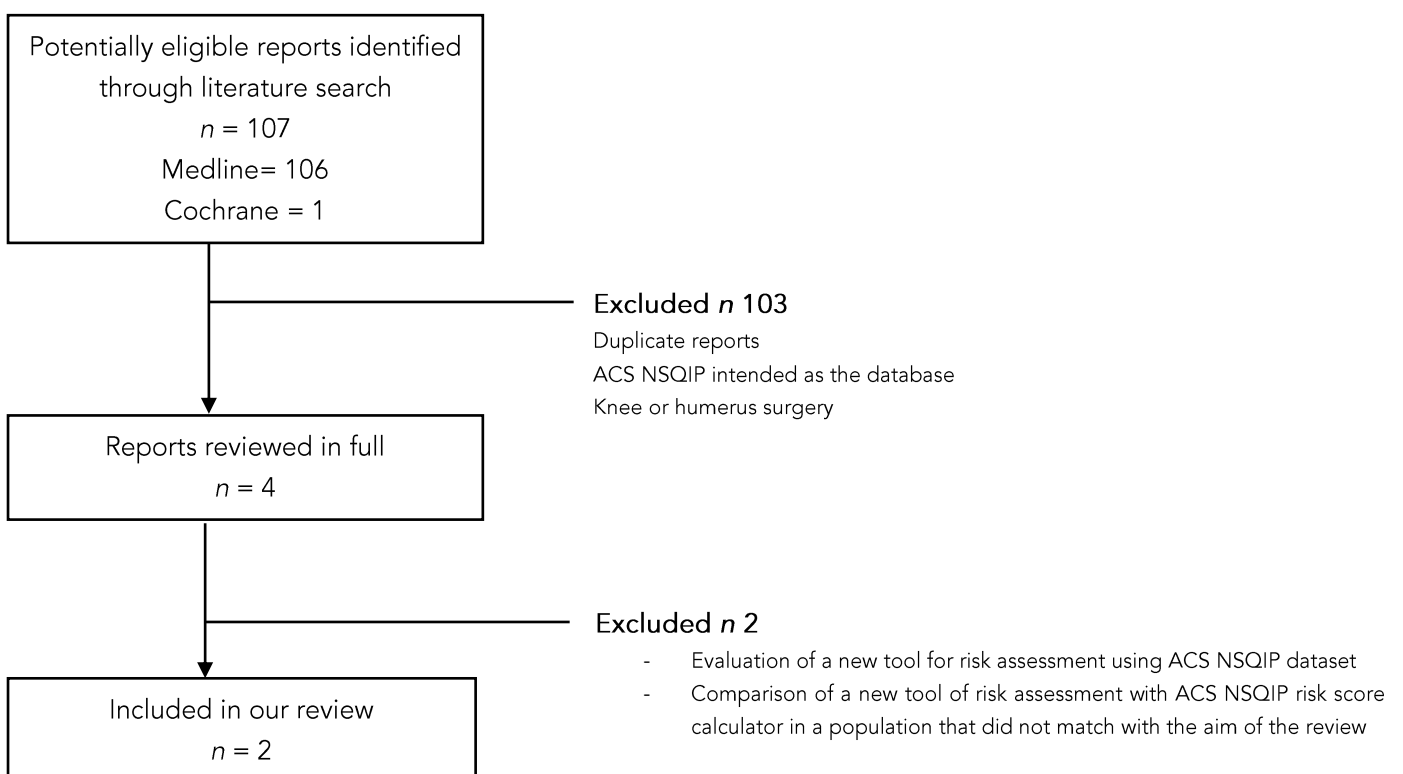


Figure 1.0 Flowchart indicating patient inclusion.

Results

A careful analysis was conducted, and we could include in our review two articles. In the first article selected, Wang et al.^[33] aim to evaluate whether the surgical risk score is able to predict postoperative complications in the elderly Chinese population undergoing orthopedic surgery for proximal femur fracture. The statistical analysis carried out by the authors showed a good correlation between the rate of incidence of postoperative complications of the ACS NSQIP risk calculator and the current rate of complications, demonstrating high specificity and sensitivity in predicting the mortality of these patients at 30 – days after surgery. The accuracy of the surgical risk calculator for predicting reoperation was 90%. The second study selected is a retrospective single cohort study analyzing data regarding patients aged 65 years or above, undergoing surgery due to proximal hip fracture^[34]. The authors evaluated the performance of four risk prediction models for 30-day and 180-day mortality. The models considered the Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM), the Portsmouth-POSSUM (P-POSSUM), the Charlson Comorbidity Index (CCI) and the American College of Surgeons National Surgical Improvement Program (ACS NSQIP) Surgical Risk Calculator. Among the four scores, the ACS-NSQIP score could be best-suited clinically and showed the highest discriminative performance, although it was not specifically designed for the hip fracture population. Two articles were deleted: Harris et al.^[35] evaluated a new tool of risk assessment proposed by the authors using the ACS NSQIP database. Dodd et al.^[36] in their study aimed to identify the rate and risk factors impacting 30-day mortality for all orthopedic trauma patients who sustained a hip or pelvic fracture. Therefore, not relevant to the aim of our review.

Discussion

The American College of Surgeons National Surgical Improvement Program (ACS - NSQIP)

Surgical Risk Calculator was developed in 2013, using personal data from the preoperative period to 30-day post-operative complications, from 1.4 million patients of 393 hospitals in the USA between 2009 and 2012. The calculator was produced using the database generated from these high-quality data. Several studies have been performed to evaluate the effectiveness of this risk calculator in different surgeries but only few focused on evaluating its effectiveness in elderly patients undergoing proximal femur fracture surgery. Aim of this review is to analyze the available literature. We performed a careful search of the relevant literature, using specific search keys. 107 studies were initially found, only four were included. After careful reading of the selected articles, two articles were excluded as they were not in line with the purpose of the review. In their study Wang et al. investigated^[34] the efficacy of ACS NSQIP risk score in 410 patients who underwent surgery for proximal femoral fracture. The study population included patients aged between 60 and 100 years, Chinese, with proximal femoral fracture. The statistical analysis, conducted with the Hosmer – Lemeshow test, showed that the predicted complication incidence was well matched with the actual complication rate. Furthermore, this study showed that the ACS NSQIP risk score has a high sensitivity and a high specificity in predicting mortality rate (C-statistic index of 0.931). Brier's score demonstrated an accuracy of 90% in predicting re – intervention. This study also revealed some weaknesses of the risk calculator. In fact, the ACS NSQIP risk score does not consider common cerebrovascular diseases, heart disease (the risk score considers only the presence of hypertension requiring medication and congestive heart failure) and, not least, there is no mention about thromboembolism risk assessment. It is very important because we must consider that elderly population has frequently more than a type of this morbidities, apart from the hip fracture. Furthermore, bone fracture increases the risk of thromboembolic manifestations, making it easy to understand how

a good predictor of post-operative complications must include elements that predict their occurrence. The average incidence of postoperative complications predicted with the ACS NSQIP score was different from what was expected: this is probably due to the lack of these specific risk factors within the calculator. Thus, by not considering these risk factors there is a possibility that the risk calculator underestimates postoperative morbidity. In contrast, the risk calculator seems to fit well in predicting postoperative mortality. This study presents some limitations. The patients treated were all critical ill patients, with significant pre-existing comorbidities. Another important limitation is the small sample size, together with the different level in medical technology and the different population characteristics between China and the country where the risk calculator was developed. The authors conclude affirming that the predictive accuracy and power of the surgical risk calculator need to be improved and further studies with larger sample sizes and more risk stratifications are necessary. In the second study taken into consideration in this review, Nia et al. conducted a retrospective analysis aiming to evaluate and compare the efficacy of four different risk scores. The scores evaluated were the Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (POSSUM), the Portsmouth-POSSUM (P-POSSUM), the Charlson Comorbidity Index (CCI) and the American College of Surgeons National Surgical Improvement Program (ACSNSQIP) Surgical Risk Calculator. The POSSUM and the P-POSSUM are tools usually used to evaluate preoperative risk. The POSSUM score was originally developed by Copeland et al. in 1991 to provide a scoring system for surgical audit^[37]. Data from 1372 patients who underwent emergency and elective surgery was processed. Logistic regression analysis yielded statistically significant equations for morbidity and mortality. It consists of 12-factor, four-grade physiological score and a six-factor, four-grade operative severity score^[38]. The clinical data that is scored is part of usual admission clinical history and

examination so in most clinical settings the cardiological, radiological and biochemical evidence is readily available^[39]. In 1998, a modified version, the P-POSSUM or Portsmouth POSSUM was derived, and is now considered a more accurate score for the mortality component. The study by Prytherch et al.^[40] found that the original POSSUM logistic regression equation for mortality overpredicted the overall risk of death by more than twofold. The **Charlson Comorbidity Index (CCI)**^[41] predicts the mortality for a patient who may have a range of comorbidities such as heart disease, AIDS, or cancer (considering a total of 17 categories). A score of zero means that no comorbidities were found; the higher the score, the higher the predicted mortality rate is. The index was developed by Mary Charlson and colleagues in 1987, but the methodology has been adapted several times since then, based on the findings of additional studies^[42]. Many variations of the Charlson comorbidity index have been presented, including the Charlson/Deyo^[43], Charlson/Romano^[44], Charlson/Manitoba, and Charlson/D'Hoeres comorbidity indices. The study of Nia et al. analyzed the original version of the score. The study was a single cohort including 1101 patients, with an average age of 83 years, 69% females, from January 2018 till December 2019. Mortality at 30 days and at 180 days were assessed. The most important finding of this study was that the ACS-NSQIP score could be best-suited clinically for the prediction of mortality. ACS-NSQIP showed the highest sensitivity and specificity, with an area under the ROC curve of 0.74 for 30-day and 0.72 for 180-day mortality. This study has some limitations. It is a retrospective study and not all data necessary for the study were available, such as intra-operative blood loss or information about the post operative period. Furthermore, it was a single center study. Finally, the authors conclude affirming that further research in the field of orthopedic trauma are needed to prove the findings of this study.

Conclusions

The articles selected in our mini review seem to show that ACS NSQIP risk score appears to be effective in predicting post-operative mortality, while the effectiveness in predicting post-operative morbidity needs to be further investigated. Unfortunately, since these are only two articles, it is impossible to express a certain opinion about the efficacy of this specific risk calculator. Strict inclusion criteria were necessary given the specific class of population under study, which represents an important problem in terms of costs for healthcare institutions. Furthermore, the correct management of the elderly patient with proximal femur fracture requiring surgery is a challenge for all medical operators involved. Several risk score assessments exist, but not enough studies are currently available to establish their effectiveness. Further studies are necessary, focused on this class of population.

Authors' contributions

AP and SB conceived the idea of this review. AP led the review process and drafted the manuscript. SP and NP contributed to every step of the review process. MT and SM provided methodological guidance for the review process and the result synthesis. All authors were involved in interpretation of results and read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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