Original Article
A comparison of general versus regional anesthesia for hip fracture surgery: a meta-analysis

Di Zuo, Chunyu Jin, Minhong Shan, Lijuan Zhou, Yanshuang Li

Operation Room, 2nd Hospital of Haerbin Medical University, Haerbin 150001, Heilongjiang, P. R. China

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Abstract: In this study, we aimed to compare the effect of general versus regional anesthesia on postoperative outcomes in patients undergoing surgical repair of hip fracture. Randomized controlled trials, prospective studies and retrospective observational studies were searched in PubMed, Medline and Embase database published between January 2005 and March 2014. The overall outcome was measured by odds ratios (ORs) and risk ratios (RRs) with their corresponding 95% confidence intervals (CIs). A total of 7 trials, involving 36448 patients received general anesthesia and 33952 patients received regional anesthesia, were included in present meta-analysis. We found that the 30-day mortality rate was lower in general anesthesia cases than that in regional cases (5.3% vs. 6.3%). Overall, our results demonstrated that there was no significant difference in 30-day mortality between two types of anesthesia in patients with hip fracture surgery (RR=0.98, 95% CI=0.92-1.04, P=0.48), indicating that types of anesthesia might not be a risk factor for hip fracture surgery. No statistically significant difference was observed in other outcome measures (P>0.05). In conclusion, our results suggested that the choice of anesthesia (general or regional) should be made by the anesthesiologist on an individual basis and based on the patient’s medical conditions. Further research is still needed to evaluate the effect of these two anesthesia methods.

Keywords: Hip fracture surgery, anesthesia, general, regional, meta-analysis

Introduction

Hip fracture surgery is a common procedure in the geriatric population [1]. The 30-day mortality is reported at between 14% and 47% and one-year mortality is estimated to be between 22% and 33% [2]. The incidence of hip fractures is increasing in many countries [3], and the percentage of elderly population at risk for falls and subsequent hip fractures is on a multifold rise as well [4]. Studies have shown that the incidence worldwide was 1.26 million in 1990 and is expected to increase to 4.5 million by 2050 [5]. In addition to the high perioperative mortality and morbidity, hip fracture is associated with extensive, expensive rehabilitation and loss of independence [6].

Outcome after hip fractures is influenced by numerous factors such as preexisting diseases, type of surgery and anesthesia. Anesthesia most commonly includes either a general or a regional anesthetic. General anesthesia, which is induced and maintained by a number of drugs, has been associated with much better hemodynamic stability than regional anesthesia [7]. Regional anesthesia, usually takes the form of a spinal or epidural injection of local anesthetic to induce surgical anesthesia, may improve outcomes by avoiding intubation and mechanical ventilation, significantly reducing blood loss and improving postoperative analgesia [8]. However, they can both result in side effects in geriatric patients. General anesthesia may induce potential complications, such as adverse reactions to drugs, increasing pulmonary complication rates, severe hypotension and postoperative nausea and vomiting [9, 10]. Regional anesthesia can lead to intraoperative hypotension, headache, neuronal damage, and can be contraindicated in patients with severe-critical aortic stenosis as well as in severe coagulation disturbances [11].

The influence of regional and general anesthesia on postoperative mortality and morbidity of the aged patients remains a controversial issue in the medical literature. A meta-analysis con-
ducted by Urwin et al. showed that there were marginal advantages for regional anesthesia compared to general anesthesia for hip fracture patients on early mortality and risk of deep vein thrombosis [12]. While Rashid et al. demonstrated that anesthesia should be tailored to individual patient requirements [13]. The purpose of this study is to determine and compare the effect of type of anesthesia on early mortality and other outcomes in patients who received general or regional anesthesia for hip fracture surgery.

Materials and methods

Search strategy

A comprehensive literature search was conducted using the electronic database of PubMed, Medline and Embase to retrieve related articles published between January 2005 and March 2014. The following key words: “anesthesia” or “regional anesthesia” or “general anesthesia” AND “hip” or “intertrochanteric” or “femoral neck” or “hip fracture surgery” as well as their combinations were used. All studies matching the eligibility criteria were retrieved, and references were checked for other relevant publications. The language was limited to English only. The search was focused on studies that were conducted in humans.

Criteria for inclusion and exclusion

The inclusion criteria were as follows: 1) all randomized controlled trials, prospective studies and retrospective observational studies comparing methods of anesthesia in patients undergoing hip fracture surgery; 2) general anesthesia versus regional anesthesia; 3) the primary outcome measure was mortality (at least 30-day mortality); and 4) statistical analysis on an intention-to-treat basis.

The exclusion criteria were: 1) duplicate studies from the same authors or laboratories; 2) reviews or conference articles; 3) studies without comparable groups; and 4) data can’t be extracted.

Quality assessment and data extraction

Two investigators independently extracted data and reached a consensus on all of the items. Any disagreement was resolved by discussing with the third expert. The following information:

Figure 1. Flow chart of literature screening.
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Data analysis

The overall outcome was measured by odds ratio (ORs) and risk ratios (RRs) with their corresponding 95% confidence intervals (CIs), which were calculated according to the method of Woolf [14]. The significance of the pooled RRs was determined by the Z test with a P value less than 0.05 considered statistically significant. The I² test and the Q-statistic test were employed to estimate the proportion and the degree of heterogeneity of included studies, respectively. The fixed-effect model was used when the effects are assumed to be homogeneous (P-value more than 0.10 for the Q-test and I² less than 50%), otherwise, the random-effect model is used when they are heterogeneous [15, 16]. Statistical analyses were conducted in Review Manager (version 5.2, The Cochrane Collaboration).

Results

Study characteristics

The electronic database search identified 83 references. Of those, 52 records were excluded after title review and 31 articles were judged
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Mortality

No significant heterogeneity between studies was detected, and the fixed-effect model was employed for calculating the pooled RR. 30-day mortality was reported in all 7 studies. Overall, we found that the mortality rate was lower in general anesthesia cases than that in the regional cases (5.3% vs. 6.3%). As shown in Figure 2, our results demonstrated that general anesthesia was not associated with a statistically significant increased risk of mortality in patients with hip fracture surgery when comparing cases with regional anesthesia (RR=0.98, 95% CI=0.92-1.04, P=0.48), indicating that type of anesthesia may not be a factor for hip fracture surgery mortality.

Two studies contained the data of 1-year mortality. Our result indicated that the regional anesthesia might be little reduced the 1-year mortality (RR=1.24, 95% CI=1.01-1.53, P=0.04) in a fixed-effect model.

Postoperative complications

Four articles reported the postoperative complications, including pulmonary complications, deep venous thromboembolism and cardiovascular complication. As shown in Figure 3, there is no difference in postoperative complications in geriatric patients undergoing regional or general anesthesia for repair of hip fracture (OR=1.28, 95% CI=0.81-2.03, P=0.28).

Sensitivity analysis and publication bias

For this meta-analysis, a single study was omitted once a time to evaluate whether each study for further review. Following abstracts screened for relevance, 17 full-text articles comprehensively assessed against inclusion criteria. Overall, the initial search with the keywords and the subject terms identified 7 publications that met the inclusion criteria and were eligible for review. Figure 1 showed the study flow. Of the 7 articles, two studies were carried out in America [2], two in UK [2], one in China [17], one in Turkey [18] and one in Pakistan [13]. Our present study involved 36448 cases with general anesthesia and 33952 cases with regional anesthesia. The major characteristics of the eligible publications were reported in Table 1.
Influenced the overall results. Our result showed that the risk ratio was not significantly affected by omitting any single study. But when study of Neuman et al. was excluded from this meta-analysis, the heterogeneity between studies was decreased ($I^2=4\%$, $P=0.39$) as shown in Figure 4.

The funnel plot for this meta-analysis of the effect of regional or general anesthesia in patients with hip fracture surgery revealed no evidence of asymmetry ($P>0.10$, Figure 5). Thus, there was no publication bias in this meta-analysis.

**Discussion**

Our meta-analysis did not find any significant difference in 30-day mortality and postoperative complications between patients who received general anesthesia compared with spinal anesthesia for surgical repair of hip fracture ($P>0.05$).

Hip fracture, a disease with declining physiological function, is an international public health problem [19]. Its prevalence is estimated to rise in line with demographic changes in population, and the median age is currently rising [20].

The choice of anesthesia for various surgical procedures remains a debate [21]. For multiple comorbid conditions of hip fracture surgery, patients were very likely to develop anesthesia-related complications. General anesthesia is referred to the use of a variety of intravenous and or inhalation drugs to render the patient unconscious. It could lead to fewer cerebrovascular accidents and shorter the time of anesthesia when compared to regional anesthesia [22]. Regional anesthesia is referred to the injection of a local anesthetic into the epidural or subarachnoid space at the lumbar spine. It is related with significantly decreased the early mortality, and reduced the cases of deep vein thrombosis, acute postoperative confusion as well myocardial infarctions, pneumonia, fatal pulmonary embolisms, and less postoperative hypoxia [23]. The general versus regional anesthesia debate is an age-old issue that has brought about few clear answers [24]. The surgical outcomes were influenced by multiple factors such as the patient, the method of regional and general anesthesia, the surgery, and the quality of perioperative care [25].

Outcomes are relatively poor and have not improved greatly over the last 20 years [26]. The 30-day mortality rate is considered a care-quality indicator following hip fracture surgery, and it is divided into 4 separate outcome categories: mortality, total complications, minor complications, and major complications [27]. Its incorporation into the latest national database report allows inter-hospital comparison of management for hip fracture surgery patients [28]. Luger et al. suggest that regional anesthesia is the preferred technique, but only with limited evidence [29]. Neuman et al. demonstrated that regional anesthesia is corrected with a lower inpatient mortality and pulmonary complications when compared with general anesthesia [30].

General anesthesia or spinal anesthesia as definitions of anesthesia might be too broad in the context of hip fracture repair. It may disguise differences between techniques of well-performed or not for anesthesia. Recent study has found that the use of regional anesthesia was not reduced the 30-day mortality but was corrected with a modestly shorter length of stay when compared with general anesthesia (Neuman, 2014 #651). And another study showed that regional anesthesia was associated with significantly greater odds of minor and total perioperative complications compared with general anesthesia (Whiting, 2015 #652). Basques et al. found that there was no clear overall advantage of one type of anesthesia over the other for patients aged 70 years and older with a fracture of the hip, and surgeons should be aware of the specific risks and benefits associated with each type (Basques, 2015 #653). Parker et al. suggested that there was no notable difference in the outcomes of hospital stay, need for blood transfusion or postoperative complications between groups (Parker, 2015 #654). Furthermore, there is great variation in anesthetic technique for hip fracture surgery [31].

There were several limitations in our study. Firstly, some of the included studies involved only small numbers of patients and limited outcome measures. Secondly, another difference was that of trial design among the reviewed articles [32]. Thirdly, more anesthesia-sensitive outcomes, such as hypotension, pain, postoperative confusion and respiratory infection should be involved in outcomes. Finally, calcu-
lation of pooled estimates for hip fracture surgery is challenging.

In conclusion, our results showed that types of anesthesia were not found to affect surgical outcomes in the two study groups. However, additional research with well-designed and large sample sizes is needed to be tailored to individual patient requirements to optimize.

Disclosure of conflict of interest

None.

Address correspondence to: Yanshuang Li, Operation Room, 2nd Hospital of Haerbin Medical University, No. 246 Xue Fu Road, Nangang District, Haerbin 150001, Heilongjiang, P. R. China. Tel: 86 045186605361; Fax: 86 045186605361; E-mail: Lys731@163.com

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