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Review

Regional anesthesia versus general anesthesia for surgery on the lumbar spine: A review of the modern literature☆

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ABSTRACT

Lumbar spine surgery can be performed using different anesthetic techniques such as general endotracheal anesthesia (GA) or spinal-based regional anesthesia (RA). Several studies have been performed comparing these two anesthetic techniques and have revealed disparate results. As such, we set out to review the relevant literature. We performed a literature search for clinical articles comparing cohorts of patients who underwent RA versus GA for lumbar spine surgeries. We compared results of these studies between groups with respect to the following outcome variables: heart rate (HR), mean arterial pressure (MAP), blood loss, duration of surgery, time spent in the PACU, post-operative analgesic use or pain scores, urinary retention rates, and nausea or anti-emetic requirements. Eleven studies were identified that compared cohorts of patients who underwent GA or RA. Of these, 4 were randomized control trials, 3 were case control trials, 2 were prospective cohorts, and 2 retrospective analyses. Seven-out-of-seven studies reported reduced HRs and MAPs in the RA compared to GA group, and 7/9 studies reported a lower incidence of post-operative analgesic requirement and/or decreased pain scores for the RA group. Our review of the literature suggests that both RA and GA are safe and effective techniques for lumbar spine surgery and that RA may prove a better alternative than GA for healthy patients undergoing simple lumbar decompression procedures or for patients who are at high risk for general anesthetic complications.

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Abbreviations: GA, general endotracheal anesthesia; RA, regional anesthesia; post-op, post-operative; HR, heart rate; MAP, mean arterial pressure; PACU, post-operative anesthesia care unit; VAS, visual analogue scale.

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1. Introduction

Lumbar and lower thoracic spinal surgery can be safely performed under a variety of anesthetic techniques. These include techniques such as general endotracheal anesthesia (GA) or a more "local" method paired with sedation that we will refer to as regional anesthesia (RA), and which includes epidural anesthesia via catheter infusion and spinal anesthesia via injection. The authors of a recent study comparing RA and GA approaches [1] proposed that the qualities of an excellent anesthetic technique should include the following features: rapid onset, ease of reversal of effects, maintenance of hemodynamic stability during operations without the need of blood transfusions, a decreased recovery room stay, as well as reduced post-op pain, nausea, vomiting, or additional anesthetic requirements.

For lower trunk and limb surgical procedures, the literature notes various advantages of RA over GA, including reduced pulmonary complications [2], intraoperative blood loss [3], perioperative cardiac ischemic incidents, hypoxic episodes, arterial and venous thrombosis [4], and decreased incidence of postoperative cognitive dysfunction, all of which suggests advantages of RA over GA in certain orthopedic procedures. Most recently, a French prospective cohort study reported that elderly patients who received GA in the past decade were significantly more likely to develop dementia than age-matched controls (relative risk 1.35, 95% CI, 1.11–1.63), suggesting another advantage of using RA over GA [5].

These findings highlight the need to explore the advantages and disadvantages of RA techniques for common spine procedures such as laminectomy and discectomy. Proposed advantages of RA over GA for spine surgery include the ability to carry out prolonged operations in the prone position without airway compromise [6,7], while also avoiding brachial plexus injury and pressure necrosis of the face because of patient self-positioning. RA also has the potential to reduce length of inpatient stays and reduce overall hospital costs.

Although spinal anesthesia is widely accepted for lower extremity surgeries and total join arthroplasties, GA is by far the most frequently used anesthetic technique for common spinal surgical procedures such as microdiscectomy or lumbar laminectomy. This may be due to greater acceptance by patients, the ability to easily extend the duration of an operation using GA, and/or anesthesiologist preference for GA because of a more secure airway establishment prior to patient placement in the prone position [8].

Nevertheless, some centers have been using regional anesthesia in lumbar spine surgery. For example, the authors of a Cleveland Clinic study state that spinal anesthesia has been routinely used at their institution for over two decades and for patients of all ages undergoing lumbar spine procedures [9–11]. Our neurosurgery group at the University of Pennsylvania, Pennsylvania Hospital, has also routinely used regional anesthesia for lumbar laminectomies and discectomies.

Although several studies have been performed comparing outcomes of RA versus GA for lumbar spine surgery, there have not been recent reports summarizing results across studies. Our goal is to review the relevant literature to identify and compare intra and post-operative outcomes between regional and general anesthetic approaches.

2. Methods

Clinical studies in the English literature that described patients undergoing either general or regional anesthesia for simple, lumbar spine surgery were identified from electronic databases including PubMed, Medline and EMBASE; Index Medicus; bibliographies of pertinent articles; and expert consultation. Review of textbooks and the "Related Articles" feature of PubMed supplemented these searches. The search strategy included various medical subject headings (MeSH) terms: general anesthesia, regional anesthesia, spinal anesthesia, epidural anesthesia, lumbar spine, spine surgery, discectomy, microdiscectomy, and laminectomy. We eliminated all non-clinical articles, as well as those articles that did not feature simple, 1–3 level laminectomy, discectomy, or microdiscectomy as the surgical procedure, those that included hardware placement, or those that featured more complex surgical procedures. We chose to focus on those surgical procedures most commonly performed, namely lumbar discectomy, laminectomy, or microdiscectomy.

The following outcome variables, compared between RA and GA groups across studies, were collected to constitute our analysis: mean heart rate (HR), mean arterial pressure (MAP), blood loss, duration of surgery, post-operative (post-op) anesthesia care unit (PACU) time, post-op narcotic use/pain scale, post-op urinary retention, and post-op nausea/anti-emetic use/vomiting. We chose to exclude the frequently featured outcome variables "surgeon satisfaction" and "patient satisfaction" because of lack of objectivity.

3. Results

3.1. Literature review

Our search yielded a total of 31 articles. We excluded studies if they did not feature any of our designated outcome variables, had confounding factors in their experimental design, showed clear demographic discrepancies between groups, or had missing statistical data. One study containing results relevant to our analysis was excluded because it did not report adequate statistical data [12].

After applying the exclusory criteria, 12 studies remained. Two of the studies were noted to feature the same data and, as such, were counted as a single study [10,11]. This yielded a final *N* of 11. Of these studies, spinal anesthesia was used as the RA technique in 8 of 11 studies and epidural anesthesia was used in 3 of 11 studies. The method of GA did not vary significantly between studies. Table 1 demonstrates an overview of study types. Table 2 demonstrates individual study characteristics.

3.2. Hemodynamic status (heart rate, mean arterial pressure, and blood loss; Table 3)

The hemodynamic status of patients was reported in all of the 11 reviewed studies in the form of one or more of the following

Table 1
Overview of study types. Featured study types include randomized control trials (RCT), case–control, prospective cohort, and retrospective studies.

Type of study	Number of studies reviewed (*N* = 11)
Randomized control trial (RCT)	4
Case control trial	3
Prospective cohort	2
Retrospective cohort	2