Comparison of surgical outcomes of lumbar disc herniation using local anesthesia and epidural anesthesia
A meta-analysis

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Abstract
We performed this meta-analysis to evaluate the effects of epidural anesthesia and local anesthesia on the surgical outcomes of lumbar disc herniation (DH).

Electronic databases including PubMed, EMBASE, Cochrane Library, and the Chinese Academic Journal Full-text Database were searched to identify randomized controlled trials (RCTs) that reported on the effects of local anesthesia and epidural anesthesia in lumbar DH surgical management. Evaluation indicators included: onset time of anesthesia, patient satisfaction, and the rate of adverse effects. There were 6 RCTs with a total of 606 patients in this meta-analysis: 274 cases in the local anesthesia group and 332 in the epidural anesthesia group.

This meta-analysis demonstrated that the epidural anesthesia group had a better analgesic effect, a lower adverse effect rate (mean difference [MD] = 0.21, 95% confidence interval [CI] [0.08, 0.54], P = .001) and a better satisfaction rate: (MD = 6.54, 95% CI [2.77, 15.45], P < .0001). The duration of anesthesia was not statistically significant.

Epidural anesthesia is a better choice for lumbar DH surgery compared to local anesthesia.

Abbreviations: CI = confidence interval, DH = disc herniation, MD = mean value, RCTs = randomized controlled trials.

Keywords: anesthesia, lumbar disc herniation, meta-analysis

1. Introduction
Lumbar disc herniation (DH) is a common senile disease occurring at the 4th and 5th lumbar intervertebral disc. Surgical and nonsurgical therapy are used for treatment. Nonoperative therapy had optimistic outcomes in patients with mild lesions or in early stages. When there is a clear diagnosis, subjects with moderate to severe pain undergo surgery.[1] Lumbar intervertebral DH surgery can cause severe pain in patients due to the long duration of surgery and need for patients to be conscious. Therefore, the requirements for anesthesia are very high.[2,3]

Previous epidemiologic studies have shown the prevalence of lumbar radiculopathy or sciatica to be around 9.8/1000.[4–6] There are several surgical and anesthetic options, but for those undergoing minimally invasive therapy, epidural injections are a common clinical practice. However, its efficacy in pain control in the lower back and lower extremities have been controversial in previous studies. The benefit of epidural steroid injections with or without a local anesthetic has also been questioned.[7] To date, only 3 randomized controlled trials have been published evaluating mid-term or long-term outcomes of fluoroscopically guided caudal epidural injections: Ackerman and Ahmed[8] only reported outcomes at 24 weeks in 30 patients; Dashfield et al[9] used only 1 injection when comparing the endoscopic delivery of steroids in 27 patients and had only 6 months of follow-up; and Manchikanti et al[10] found positive results at 1-year follow-ups in a practical, clinical setting.

Reducing the risks of anesthesia, ensuring a smooth operation, and reducing the patient’s pain require the right choice of anesthesia. At present, the most common types of anesthesia in lumbar DH surgery are epidural anesthesia and local anesthesia. By comparing the advantages and disadvantages of epidural anesthesia and local anesthesia on lumbar DH, results were analyzed to provide a reference for the appropriate selection of clinical anesthesia.

2. Materials and methods
2.1. Search strategy
The electronic databases PubMed, EMBASE, Cochrane Library, and The Chinese Academic Journal Full-text Database were...
searched for randomized controlled trials (RCTs) that reported on the effects of local anesthesia and epidural anesthesia on lumbar DH surgery from January 2000 until September 2019. The English search words used were ((((lumbar disc herniation [MeSH Terms]) OR (lumbar disc herniation [CINAHL])) AND ((local anesthesia [MeSH Terms]) OR (local anesthesia [CINAHL])) OR ((epidural anesthesia [MeSH Terms]) OR (epidural anesthesia [CINAHL])))) AND Human [MeSH Terms].

In order to make use of keywords such as (lumbar disc herniation) AND (anesthesia), the Chinese search strategy was used to retrieve the keywords in combination with free words. The literature migration risk summary chart is shown in Figure 1 and the flow chart is shown in Figure 2.

2.2. Inclusion and exclusion criteria
The inclusion criteria were: randomized controlled studies on lumbar DH surgery in adult patients with epidural anesthesia; full text availability of the research report; and the ability to extract outcomes including adverse events (defined as anesthesia-related neurological complications, vomiting, urinary retention, defecation/flatus, nausea, intra-operative abnormal heart rate or blood pressure), patient satisfaction, and anesthesia-related complications. The studies ideally conducted a comparison between local and epidural anesthesia, but this was not required to conduct a double-blind study.

The exclusion criteria were: the existence of multiple research reports by the same author at the same time as an independent study, studies without full text, incomplete data, or data that could not be extracted. Animal experiments, summaries of meetings, summaries, and meta-analyses were also not included in the study.

2.3. Target observation
The target observations were: onset time of anesthesia, patient satisfaction, and rate of adverse effects.

2.4. Data extraction and analysis
The literature was screened independently by 2 evaluators. When different opinions occurred, the meta-analysis software RevMan 5.3 was used. The heterogeneity of each study was analyzed by the \( \chi^2 \) test \( (P < 0.05) \). The difference was statistically significant, and the degree of heterogeneity was determined using \( I^2 \). Heterogeneity is considered small when \( I^2 < 50\% \) and the fixed-effect model is adopted. When \( I^2 > 50\% \), heterogeneity is considered large, and the random-effect model is adopted. The data included in this study were counted and the mean value (MD) analysis was applied to the 95% confidence interval (CI). In total, 6 studies (11–16) were included in this meta-analysis, with a total of 606 patients: 274 in the anesthesia group, and 332 in the epidural anesthesia group. Adverse events related to anesthesia were defined as: nerve-related complications, transient paresis, decreased muscle strength of the lower limbs, nausea and vomiting, and dysuria.

3. Ethical declaration
All the studies we included had been approved by their local institutional review boards and informed consent was obtained.

4. Results
The baseline characteristics of the studies are shown in Table 1.
After the screening, 3 studies could be extracted that discussed onset time of anesthesia. The heterogeneity test showed $P=0.53$, $I^2=99\%$, and therefore the random-effects model was used. The results indicated that there was no significant difference between the 2 groups in relation to the onset time of anesthesia ($P<0.00001$), $MD=2.73$, 95% confidence interval (CI) (−5.79, 11.25), as shown in Figure 2. This suggested that there was no difference between the epidural anesthesia group and the local anesthesia group for onset time of anesthesia.

For patients’ satisfaction with anesthesia (evaluated as “good”), 3 studies were found after screening. The heterogeneity test showed that $P=0.52$, $I^2=0\%$, with mild heterogeneity, so the fixed-effects model was used. The results indicated that the difference between the 2 groups was statistically significant ($P<0.0001$), $MD=6.54$, 95% CI (2.77, 15.45), as shown in Figure 3. This showed that the rate of patient satisfaction in the epidural anesthesia group was higher than that in the local anesthesia group.

After screening for the adverse reaction rate of anesthesia, the data from 2 studies were extracted. The heterogeneity test showed that $P=0.73$, $I^2=0\%$, with mild heterogeneity, so the fixed-effect model was used. The results indicated that the differences between the 2 groups were statistically significant ($P=0.001$), $MD=0.21$, 95% CI (0.08, 0.54), as shown in Figure 4. This indicated that the epidural anesthesia group had a lower adverse reaction rate than the local anesthesia group.

5. Discussion

Under the influence of external forces, different areas of the intervertebral disc may have degenerative disease, which leads to fibrous damage of the intervertebral disc and eventually to the occurrence of lumbar DH. Patients with lumbar DH often have pain and numbness in the lower limbs and daily life is seriously affected. At present, lumbar surgery is often used in clinic. Local anesthesia and epidural anesthesia are common methods used during the surgical treatment of lumbar DH. Local and epidural anesthesia have different advantages and disadvantages when they are used for lumbar DH surgery.

A small amount of epinephrine is added to the local anesthetic, which can shrink capillaries, provide local hemostasis of the wound, reduce bleeding of incision tissue, and make the operation field clearer. Local anesthesia is also easy to administer according to the location of the herniated disc. The local anesthesia fee is also low and reduces the patient’s hospitalization expenses. Although it is usually administered according to the surface positioning and the sacral slope position of the lamina, if the lumbosacral angle of the individual patients is smaller it is not

### Table 1

| Study          | Year | Total subjects | Epidural | Local | Treatment  |
|----------------|------|----------------|----------|-------|------------|
| Huang et al[4] | 2014 | 67             | 34       | 33    | Discetomy  |
| Ren et al[5]   | 2006 | 40             | 20       | 20    | Endoscopic |
| Shi[6]         | 2015 | 110            | 55       | 55    | Discetomy  |
| Chang et al[7] | 2016 | 50             | 25       | 25    | Endoscopic |
| Bu et al[8]    | 2006 | 247            | 152      | 95    | Discetomy  |
| Wang et al[9]  | 2017 | 92             | 46       | 46    | Discetomy  |

![Figure 3](image3.png)  
**Figure 3.** Forest plot comparing good rate of anesthesia between the 2 groups.

![Figure 4](image4.png)  
**Figure 4.** Forest plot comparing adverse reactions between the 2 groups.
obvious or can be difficult to touch the sacral slopes during the operation, and the location is not clear. However, because of nerve root dissection or when the nerve root sheath is inadequate, patients have suffered obvious symptoms of nerve stimulation. Patients may be nervous due to pain, increased blood pressure, increased abdominal pressure, and increased incision bleeding, which could affect the surgical field of view.

Epidural anesthesia is widely used in clinic. The main site of epidural anesthesia is in the epidural space and is a block anesthetic. When the anesthetic is injected into the epidural space, the spinal nerve root can be blocked and the controlled areas produce good anesthetic effects.\(^{[12]}\) The anesthetic effect of this method is clear, the depth of anesthesia is easily maintained, and the dosage of the medicine is less. Epidural anesthesia greatly reduces damage to the nerves and the incidence of postoperative complications.\(^{[13]}\) However, the downside is the anesthesia time is long, the cost of anesthesia is slightly higher, and postoperative epidural anesthesia nursing is required.

Epidural anesthesia results in fewer adverse reactions and has greater analgesic effect. Continuous epidural anesthesia can block sensory nerves directly and can include analgesics. Additionally, it can block muscle spasms that cause further pain. At the same time, it relieves pain at the nerve root and the surrounding tissue from disc protrusion, which can reduce the patient’s discomfort. There is no difference in onset time of anesthesia between the 2 anesthesia methods.

This meta-analysis demonstrated that epidural anesthesia use during lumbar DH surgery has greater benefits than local anesthesia. Low concentrations of epidural ropivacaine could prevent pain effectively during surgery but maintain the motor function of lower limbs allowing the surgeon to continue to get feedback from the patient. However, some of our studies were published in Chinese and therefore it could be difficult for some clinicians to obtain the original studies. Additionally, there may be some publication bias among the different definitions for adverse effects in the studies. At present, we suggest epidural anesthesia for those who are suitable for this surgery. However, the clinical reports regarding other potential factors are insufficient so we still need more data for future analysis.

**Author contributions**

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