Acta Orthop. Belg., 2022, **88**, 661-665

ORIGINAL STUDY

doi.org/ 10.52628/88.4.9922

Local anesthesia, epidural anesthesia and general anesthesia comparison in lumbar disc herniation: a network meta-analysis

Wei Wang, Bin-bin Ni, Hao Shen, Hua Lu

From the Department of Orthopaedics, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China.

There were 3 major anesthesia methods for discectomy: local, epidural and general. A lot of studies has been established to compare these three methods in different aspects, however, the result is still controversial. We conducted this network meta-analysis to evaluate these methods. Electronic databases including PubMed, EMBASE, Cochrane Library, were searched to identify clinical trials that reported the effects of local anesthesia general anesthesia and epidural anesthesia in lumbar disc herniation. Three indicators were included for evaluation: post-operative VAS score, complication, operation duration. In total, 12 studies and 2287 patients were included for this study. For complication, epidural anesthesia shows significantly lower rate compare to general anesthesia (OR: 0.45, 95% CI [0.24, 0.45], P=0.015), but local anesthesia didn't show significant result, no significant heterogeneity was observed between designs. For VAS score, epidural anesthesia showed a better effect (MD: -1.61, 95%CI [-2.24, -0.98]) compare to general anesthesia, and local anesthesia has a similar effect (MD: -0.91, 95%CI [-1.54, -0.27]). However this result showed a very high heterogeneity (I^2=95%). For operation duration, local anesthesia showed a significant lesser time compare to general anesthesia (MD: -46.31(minutes), 95%CI [-73.73, -19.19]) but epidural anesthesia didn't have one, this result also showed a very high heterogeneity (I^2=98%). Epidural anesthesia showed lesser post-operative complication compare to general anesthesia in lumbar disc herniation surgery.

Funding: None.

Conflicts of interest: The authors declare no conflicts of interest.

Keywords: Local anesthesia; epidural anesthesia;general anesthesia;lumbar disc herniation;network meta-analysis.

INTRODUCTION

Lumbar disc herniation is a common senile disease. The site is the 4th and 5th intervertebral disc of lumbar vertebra. Usually surgery and non-surgical treatment would be conducted for these patients *(1)*. Lumbar intervertebral disc herniation surgery can cause severe pain to patients, since its duration is usually long and requires patient awaken, so the requirements for anesthesia are very high *(2)*. Reducing the risk of anesthesia, ensuring the smooth operation of the operation and reducing the pain of the patient requires the right choice of anesthesia. At present, the most common anesthesia in lumbar disc herniation surgery is epidural anesthesia (EA), local

■ Wei Wang,
■ Bin-bin Ni,
■ Hao Shen,
■ Hua Lu
Department of Orthopaedics, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, No. 1665 Kongjiang Road, Shanghai, 200092, China..

Correspondence : Hua Lu, Department of Orthopaedics, Xinhua Hospital, Shanghai Jiaotong University School of Medicine, No. 1665 Kongjiang Road, Shanghai, 200092, China. Phone: +86-021-25077955. Fax: +86-21-25077970.
Email : luhua1232021@163.com

anesthesia (LA) and general anesthesia (GA). By comparing the effects of these three methodology on lumbar disc herniation, the advantages and disadvantages were analyzed to provide a reference for the selection of clinical anesthesia.

MATERIALS AND METHODS

Electronic databases including PubMed, EMBASE, Cochrane Library, Clinicaltrial.gov were searched to identify clinical trials that reported the effects of local anesthesia and epidural anesthesia in lumbar disc herniation after 2000. Following search strategy were established in PubMed:

#1 Search ((epidural anesthesia [MeSH Terms]) OR local anesthesia [MeSH Terms]) OR general anesthesia [MeSH Terms]

#2 Search (lumbar disc herniation [MeSH Terms]) OR discectomy [MeSH Terms]

Search #1 AND #2

Similar strategy was conducted on EMBASE, Cochrane library and Clinicaltrial.gov.

Inclusion Criteria: A clinical study with control group on the operation of lumbar disc herniation in adult bureau and epidural anesthesia; The full text of the research report can be obtained in English and able to extract data.

Exclusion Criteria: Multiple research reports of the same author at the same time as an independent study; A document without full text, incomplete data, or data that cannot be extracted. Animal study, reviews, Meta-analysis, etc. are not included in the study. The flowchart was shown as Figure 1.

Operation duration, complication, post-operative >24h VAS score. We define complication as anesthesia related complication, including neurological complication and vomiting, urinary retention, defecation/ flatus, nausea, intra-operative abnormal heart rate or blood pressure.

The literature was screened independently by two evaluators, Binbin Ni and Wei Wang, if there were different opinions, a third reviewer Hao Shen would make a final decision. The meta-analysis software was adopted by R version 3.6.1 (R Development Core Team (2019). R: A language and environment

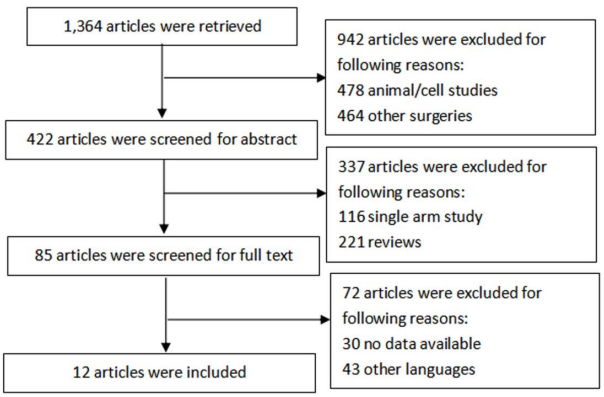

Figure 1. — Flow chart of article inclusion.

for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org.). The heterogeneity of each study was analyzed by X^2test ($P < 0.05$,The difference was statistically significant, and the size of the heterogeneity was determined according to I^2. If I^2 is greater than 50%, we would define it as high heterogeneity. All analysis would be conducted in random effect model. We collected mean value (MD), logOR as is applied to 95% confidence interval (CI). Finally, 12 studies *(3-14)* were included in this study, with a total of 2,287 patients, 431 LA, 1,260 EA, 596 GA cases.

RESULTS

All included studies' data collected treatment effect (TE) for indicators were shown as Table I-III including complication, operation duration and >24h VAS score. For complication, 11 studies reported complication indicators, in total 2,192 subjects, 1,211 EA cases, 385 LA cases and 596 GA cases. Overall the EA shows a significantly lower complication occurrence compare to GA, OR:0.45, 95% CI [0.24, 0.45], P=0.015; but LA didn't show a significant improvement compare to GA, as shown in Figure 2 (above). The overall heterogeneity between designs were low I^2=0%.

For operation duration, there were 8 studies reported this indicator, in total 1,723 subjects included for this section, including 1,016 EA cases, 513 GA cases and 194 LA cases. The LA shows

Table I. — Indicators for complication

Studies	TE	seTE	treat1.n	treat1	treat2.n	treat2
Zhu et al., 2018 [3]	-1.85	0.57	80	LA	80	EA
Fang et al., 2016 [4]	0.28	0.38	121	LA	165	EA
Zhu et al., 2017 [5]	-0.28	0.46	65	LA	67	EA
Wang et al., 2017 [6]	-1.84	0.56	46	EA	46	LA
Ulutas et al., 2015 [7]	-1.02	0.42	573	EA	277	GA
Demirel et al., 2003 [8]	-1.19	0.57	30	EA	30	GA
Chen et al., 2011 [9]	-0.69	0.47	73	LA	50	GA
McLain et al., 2005 [10]	-1	0.37	100	EA	100	GA
Vural et al., 2014 [11]	-0.24	0.5	33	GA	33	EA
Dagistan et al., 2015 [12]	-0.44	0.33	90	EA	90	GA
Papadopoulos et al., 2006 [13]	-1.75	0.73	27	EA	16	GA

TE were collected by logOR, seTE: standard error of TE.

Table II. — Indicators for operation duration

Studies	TE	seTE	treat1.n	treat1	treat2.n	treat2
Zhu et al., 2018 [3]	-17.7	1.47	80	LA	80	EA
Zhu et al., 2017 [5]	-20.23	1.47	65	LA	67	EA
Xu et al., 2019 [14]	-53.8	5	49	LA	49	EA
Ulutas et al., 2015 [7]	-5.21	1.52	573	EA	277	GA
Demirel et al., 2003 [8]	-18.8	8.1	30	EA	30	GA
McLain et al., 2005 [10]	-15	21.38	100	EA	100	GA
Dagistan et al., 2015 [12]	-38	0.96	90	EA	90	GA

TE were collected by MD (in minutes), seTE: standard error of TE.

Table III. — Indicators for >24h post-operative VAS score

Studies	TE	seTE	treat1.n	treat1	treat2.n	treat2
Zhu et al., 2018 [3]	0.46	0.04	80	LA	80	EA
Zhu et al., 2017 [5]	0.35	0.05	65	LA	67	EA
Xu et al., 2019 [14]	0.75	0.16	46	LA	49	EA
Wang et al., 2017 [6]	-0.37	0.25	46	EA	46	LA
Demirel et al., 2003 [8]	-3.24	0.24	30	EA	30	GA
Chen et al., 2011 [9]	-0.06	0.11	73	LA	50	GA
Vural et al., 2014 [11]	0	0.69	33	GA	33	EA

TE were collected by MD, seTE: standard error of TE.

a significantly shorter time compare to GA, MD: -46.31(minutes),95%CI [-73.73, -19.19], and EA shows a trend, but not significant result compared to GA, MD: -16.25 (minutes), 95%CI [-33.75, 1.25], as shown in Figure 2 (middle). However, due to the high heterogeneity I^2= 98%, this result might not robust.

For post-operative >24h VAS score difference, EA shows a better anesthesia effect (MD: -1.61, 95%CI [-2.24, -0.98]) compare to GA, and LA has

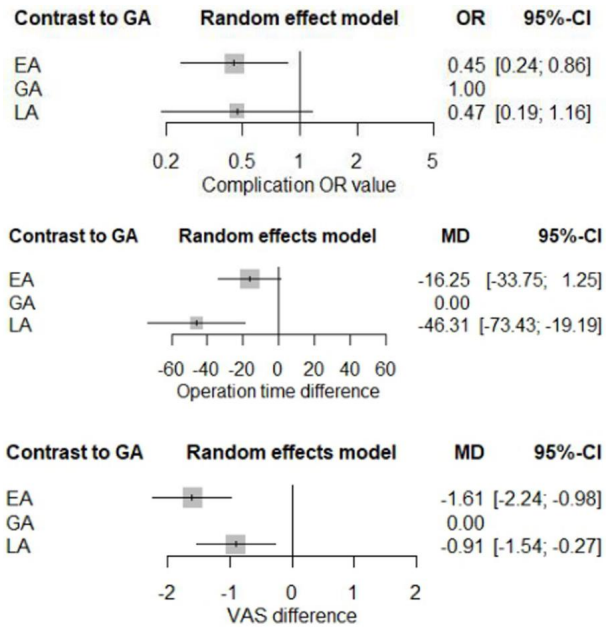

Figure 2. — Forest plots for Complication (above), operation duration (middle) and VAS (below).

a similar effect (MD: -0.91, 95%CI [-1.54, -0.27]), as shown in Figure 2 (below). However, it showed a very high heterogeneity (I^2=95%), this result might not robust.

We compared other indicators from studies including satisfaction rate, ODI score or X-ray exposure, no significant result was observed or not enough data (less than 4 studies) was collected (data not shown).

DISCUSSION

Under the influence of external force, different parts of intervertebral disc may appear degenerative diseases, which lead to fibrous damage of intervertebral disc, and eventually lead to the occurrence of lumbar disc herniation. Patients with lumbar disc herniation often have pain and numbness in the lower limbs, and it seriously affects daily life *(15)*. At present, lumbar surgery is often used in clinic. Local anesthesia and epidural anesthesia are the common anesthesia methods for the treatment of lumbar disc herniation. It has different advantages and disadvantages when local anesthesia and epidural anesthesia were used in the operation of lumbar disc herniation.

A small amount of epinephrine is added to the local anaesthetic drug, which can shrink capillaries; local hemostasis of wound; reduce bleeding in incision tissue and make the operation field more clearly. Local anesthesia is easy to operate. After spreading disinfectant towels, local anesthesia can be performed according to the location of the intervertebral space. Local anesthesia is beneficial to the localization of intervertebral space during operation. Also, The local anesthesia fee standard is low and saves the patient's hospitalization expenses *(16)*. Although we usually according to the surface positioning and the sacral slope position of lamina to location, if the lumbosacral angle of the individual patients is smaller, or the lumbosacral vertebrae of the patients are lumbosacral or lumbosacral, it is not obvious or difficult to touch the sacral slopes during the operation, and the location is not clear. However, because of the dissection of nerve roots and sometimes the nerve root sheath is ineffective, patients suffered obvious symptoms of nerve stimulation. The patient was nervous due to pain, increased blood pressure, increased abdominal pressure, increased incision bleeding, and affected the surgical field of view.

Epidural anesthesia is widely used in clinic. The main anesthesia site of epidural anesthesia .is epidural space and the anesthesia route is block anesthesia. When the anesthetic drug is injected into the epidural space, the spinal nerve root can be blocked, and controlled areas produce good anesthetic effects *(17)*. On the other hand, the anesthetic effect of this anesthetic method is obvious, the depth of anesthesia is maintained, and the dosage of the required medicine is less. It greatly reduces the damage to the nerves, the incidence of postoperative complications also decreased significantly, and effectively ensuring the smooth implementation of the operation. However, the drawback is that the anesthesia time is long, the cost of anesthesia is slightly higher, and need postoperative epidural anesthesia nursing.

This network meta-analysis showed that EA has some privilege among GA in complication, the other two indicators: VAS and operation duration

showed too high heterogeneity, might be correlated to doctors' experience or procedure in different sites.

Abbreviations: *EA: epidural anesthesia; LA: local anesthesia; GA: general anesthesia; MD: mean value; CI: confidence interval; TE: treatment effect.*

REFERENCES

1. **Deyo, R.A., Mirza, S.K.** CLINICAL PRACTICE. Herniated Lumbar Intervertebral Disk. N Engl J Med. 2016;374(5),1763-1772.
2. **Gibson, J.A., Cowie, J.G., Iprenburg, M.** Transforaminal endoscopic spinal surgery: the future 'gold standard'for discectomy?–A review. Surgeon. 2012;10, 290-296.
3. **Zhu, Y., Zhao, Y., Fan, G., Sun, S., Zhou, Z., Wang D., *et al.*** Comparison of 3 Anesthetic Methods for Percutaneous Transforaminal Endoscopic Discectomy: A Prospective Study. Pain Physician. 2018;21(7), E347-E353.
4. **Fang, G., Ding, Z., Song, Z.** Comparison of the Effects of Epidural Anesthesia and Local Anesthesia in Lumbar Transforaminal Endoscopic Surgery. Pain Physician. 2016; 19(7), E1001-1004
5. **Zhu, Y., Zhao, Y., Fan, G., Gu, G., Sun, S., Hu, S., *et al.*** Comparison of the effects of local anesthesia and epidural anesthesia for percutaneous transforaminal endoscopic discectomy in elderly patients over 65 years old. Int J Surg. 2017;48(12), 260-263.
6. **Wang, S.J., Chen, B.H., Wang, P., Liu, C.S., Yu, J.M., Ma, X.X.** The effect of percutaneous endoscopic lumbar discectomy under different anesthesia on pain and immunity of patients with prolapse of lumbar intervertebral disc. Eur Rev Med Pharmacol Sci. 2017;21(6), 2793-2799.
7. **Ulutas, M., Secer, M., Taskapilioglu, O., Karadas, S., Akyilmaz, A.A., Baydilek, Y., *et al.*** General versus epidural anesthesia for lumbar microdiscectomy. J Clin Neurosci. 2015;22(8), 1309-1313.
8. **Demirel, C.B., Kalayci, M., Ozkocak, I., Altunkaya, H., Ozer, Y., Acikgoz, B.** A prospective randomized study comparing perioperative outcome variables after epidural or general anesthesia for lumbar disc surgery. J Neurosurg Anesthesiol. 2003;15(7), 185-192.
9. **Chen, H.T., Tsai, C.H., Chao, S.C., Kao, T.H., Chen, Y.J., Hsu, H.C., *et al.*** Endoscopic discectomy of L5-S1 disc herniation via an interlaminar approach: Prospective controlled study under local and general anesthesia. Surg Neurol Int. 2011;2, 93.
10. **McLain, R.F., Kalfas, I., Bell, G.R., Tetzlaff, J.E., Yoon, H.J., Rana, M.** Comparison of spinal and general anesthesia in lumbar laminectomy surgery: a case-controlled analysis of 400 patients. J Neurosurg Spine. 2005;2(1),17-22.
11. **Vural, C., Yorukoglu, D.** Comparison of patient satisfaction and cost in spinal and general anesthesia for lumbar disc surgery. Turk Neurosurg. 2014;24(3), 380-384.
12. **Dagistan, Y., Okmen, K., Dagistan, E., Guler, A., Ozkan, N.** Lumbar Microdiscectomy Under Spinal and General Anesthesia: A Comparative Study. Turk Neurosurg. 2015; 25(5), 685-689.
13. **Papadopoulos, E.C., Girardi, F.P., Sama, A., Pappou, I.P., Urban, M.K., Cammisa, F.P. Jr.** Lumbar microdiscectomy under epidural anesthesia: a comparison study. Spine J. 2006;6(5), 561-564.
14. **Xu, T., Tian, R., Qiao, P., Han, Z., Shen, Q., Jia, Y.** Application of continuous epidural anesthesia in transforaminal lumbar endoscopic surgery: a prospective randomized controlled trial. J Int Med Res. 2019;47(3), 1146-1153.
15. **Mergeay, M., Verster, A., Van Aken, D., Vercauteren, M.** Editorial Regional versus general anesthesia for spine surgery. A comprehensive review. Acta Anaesthesiol Belg. 2015;66(1),1-9.
16. **Manchikanti, L., Pampati, V., Benyamin, R.M., Hirsch, J.A.** Cost Utility Analysis of Lumbar Interlaminar Epidural Injections in the Treatment of Lumbar Disc Herniation, Central Spinal Stenosis, and Axial or Discogenic Low Back Pain. Pain physician. 2017;20(5), 219-228.
17. **Jordan, J.L., Konstantinou, K., O'Dowd, J.** Herniated lumbar disc: injection interventions for sciatica. BMJ Clin Evid. 2009; pii: 1118.