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The role of endoscopic spinal surgery for the management of degenerative spinal diseases

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ABSTRACT

Background: Degenerative spinal disease increases in proportion to life expectancy. Surgical treatments that play an essential role in the management of degenerative spinal disease have evolved from open surgery to minimally invasive surgery as well as endoscopic spinal surgery. Advanced pathological understanding, diagnostic imaging, and instrument progress have support for endoscopic spinal surgery. The study aims to report the current situation of endoscopic spinal surgery to treat degenerative spinal diseases in the Department of Neurosurgery of Kariadi Hospital.
Method: Review the Endoscopy Spine Surgery case in the Department of Neurosurgery of Kariadi Hospital with degenerative spinal diseases including canal stenosis and disc herniation at all levels.
Results: A total of 123 degenerative spinal diseases have been treated with endoscopic spinal surgery. Most of patients comes with HNP (89 patients, 72.4%) and operated in lumbal segment (87 patients, 70,7%). Estimated blood loss parameter in <50 years group had mean 72.85 ± 44.79 ml and >50 years group had mean 115.00 ± 95.25 ml with p=0.001. We got high correlation between operation time and estimated blood loss with r = 0.779 and statistically significant (p=0.000).
Conclusion: Endoscopic surgery appears to be an option for treating degenerative spinal diseases especially for herniation and canal stenosis. The lumbar and thoracic regions are common areas for endoscopic spinal surgery.

Keywords: degenerative spine disease, endoscopy spine surgery, disc herniation, canal stenosis.
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INTRODUCTION

A 266 million people (36.3%) suffered from low back pain and diagnosed with degenerative spinal disease each year. The highest incidence rates were found in Europe (5.7%) and lowest incidence was found in Africa (2.4%). The distribution of cases depends on demographics area, with low to middle-income countries having 4 times higher prevalence than high-income countries. Although surgical pathology is estimated represent almost 30% of all patients, only one-third had access to surgical facilities and nearly 5 billion people who lack access to primary surgical care.[1,2]

New concept for degenerative spinal disease medical treatment has shifted from open spine surgery into minimally invasive spine surgery. Development of imaging modality is possible to identify spinal pathology in degenerative disk, and can be diagnosed very accurately and handled with minimally invasive methods. In cervical, thoracic and lumbar segments, minimally invasive spinal surgery may be performed with visual modifications, high-resolution camera, light source, high-speed burr, irrigation pump, with different endoscopic techniques.[3,4]

Endoscopy spine surgery was introduced by Kambin and Gellman in 1983, a technique for non visualized percutaneous needle nucleotomy for symptomatic degenerative disc disease. The critical technological advancement was taken in 1983 by Forst and Hausmann, introducing endoscopy method through direct visualization of disc decompression. Destandau introduced Endoscopy Lumbar discectomy in 1993 using mobile retractor as a working channel via interlaminar approach.[5] In 1997, Foley and Smith use a tubular retractor via a paramedian approach to assessing pathology side in the spine.[6]

By years, many methods with high-quality visualization and treatment of various spinal pathology using endoscopy. Nowadays, modern endoscopy spine surgery can be performed for the treatment primary and recurrent disc disease, spinal stenosis and spondylolisthesis.[3]

Significant innovations had been made for development of minimally invasive surgery, especially endoscopy spine surgery in recent years. Primary endoscopy lumbar surgery had to minimize the structural and clinical impact of the surgical approach. Smaller surgical incision and procedure come a lower risk of infection, less blood loss and less overall soft tissue trauma. In spine surgery, maintenance of structural integrity and paraspinal muscle innervation and less epidural scarring is thought to facilitate post-operative

outcome and patient satisfaction. Using endoscopy, also reduced operative time and decreased general anesthesia need, also likely to lead to reduced post-operative hospital stay, early functional recovery, better quality of life and overall cost.[7]

This paper will share our experience in the role of endoscopy spine surgery in degenerative disease management in Kariadi Hospital.

METHODS

Subjects

From January 2015 to June 2020, a total of 123 patients with various degenerative spinal pathologies were enrolled in this study. All subjects were operated in the neurosurgery department of Kariadi Hospital. The age of the patients was 15-83 years, with 50.95±11.97 years on average. The course of the illness varied from 1 month to 11 years. The ethics committee of Kariadi General Hospital accepted this report. Written consent from respondents was obtained.

Inclusion and exclusion criteria

The conditions for inclusion criteria were as follows: (1) patients showed radicular pain symptoms, intermittent claudication, discomfort in the lumbar, numbness in lower extremity, paravertebral pain radiation, lower motor weakness. (2) patients diagnosed by radiological study (X-Ray, CT scan and/or MRI) with hernia nucleus pulposus, degenerative disc disease or spinal stenosis. The conditions for exclusion were instability of spinal vertebrae, history of open spine surgery, severe organ dysfunction, pregnancy, and psychiatric illnesses.

Surgical methods

Under general anesthesia, the patients were in the place of prone position and maximal flexion. C-arm X-rays were used to determine the skin orientation of the surgical tract to the pathologic disc. After surgical draping, skin incision was made just lateral of the spinous process in the side of clinical symptom. Fascia was sharply cut using scissors, paraspinous muscle was dissected base to the bone of spinous process and lamina to the lateral. After lamina and interlaminar of pathologic level were achieved, mobile scope was introduced and again the level of the pathologic was checked with lateral C-arm X rays.

The foramen intervertebral was widened by partial drilling of the lower lamina and flavectomy. For the ligamentum flavum hypertrophy surgery was continued with contralateral flavectomy until enough decompression was achieved. For the disc pathology, identification of the disc was done by palpation with nerve retractor. After protection of the dura mater, discectomy was performed using forceps, flirr, simultaneously. Evacuation and decompression were achieved after pulsation of the dura mater were seen in surgery field and the working channel was put in place.

Postoperative treatment

The patients completed the ambulation after 1-3 days of treatment. To minimize nerve root adhesion, the auxiliary leg-raising exercise was performed during post-operative period. Moderate testing of the back muscles was carried out after.

Statistical analysis

All statistical analyses were carried out using SPSS 22.0 software. The measurement data were presented as mean ± standard for numerical data and number (percent) for categorical data. Normality data will be conducted. For normal data, independent t-test and correlation test will perform to analyzed operation outcome.

RESULT

We got 123 patients who performed endoscopy surgery in Kariadi General Hospital from period 2015 – 2020. Most of patients comes with HNP (89 patients, 72.4%) followed by spinal stenosis. Most patients are operated in lumbal segment (87 patients, 70.7%) followed by lumbosacral, thoracal and cervical. Operation mostly performed are endoscopic discectomy (86 patients, 60.99 %) (Table 1).

From age analysis, overall mean age is 52 years with SD 11.48. The youngest patient was 22 years old and the oldest was 83 years old. From location analysis, patients with cervical segment, had the

Table 1. Descriptive statistics for endoscopy spine surgery

Variable		Frequency	Percent
Location	Cervical	3	1.6
	Thoracal	26	13.0
	Lumbal	87	70.7
	Lumbosacral	18	14.6
	Total	123	100
Pathology	Stenosis	34	27.6
	HNP	89	72.4
	Total	123	100
Operation	Encoscopic anterior discectomy	2	1.6
	Endoscopic discectomy	86	69.99
	Endoscopy flavectomy	35	28.5
	Total	123	100

Table 2. age comparison between each variable

Variable			Mean	SD
Age	Location	Cervical	53.00	8.48
		Thoracal	51.18	9.20
		Lumbal	52.35	12.46
		Lumbosacral	51.27	8.87
	Pathology	Stenosis	54.47	12.30
		HNP	51.13	11.08
	Operation	Encoscopic anterior discectomy	53.00	8.48
		Endoscopic discectomy	51.03	11.30
		Endoscopy flavectomy	54.19	11.92
	Overall		52.05	11.48

Table 3. Operation time and estimated blood loss analysis

	Age (year)	N	Mean	Std. Deviation	p-value
Operation time	<50	14	117.85	26.07	0.259
	>50	14	127.50	31.05	
Estimated blood loss	<50	14	72.85	44.79	0.001*
	>50	14	115.00	95.25	

*Independent T test, Statistically significant p<0.05

Table 4. Correlation between estimated blood loss and duration of operation

		Estimated blood loss
Operation time	Correlation coefficient (pearson)	0.779*
	p	0.000**

*r = 0.779 (0.70 – 0.89) high correlation **p<0.05 statistically significant

most senior mean age (53.00±8.48 years). From pathology, the oldest mean age is spinal stenosis (54.47±12.34 years). From operation, the youngest age is endoscopic discectomy, followed by endoscopic anterior discectomy and endoscopic flavectomy (Table 2).

From all subjects, 28 patients who had similar pre-operative condition, diagnosis, and treatment, including to be analyzed. We determined operation time and estimated blood loss as parameter for operation outcome. From 28 patients, we divided into to 2 groups based on age. The first group is subjects under 50 years old and more than 50 years old. We compared the outcome difference between that group.

We got 14 patients who had age <50 years and 14 patients who had age ≥ 50 years. From operation time parameter, <50 years group had mean operation time 117.85 ± 26.07 minutes. ≥ 50 years group had mean operation time 127.50±31.05 minutes with p=0.259. Estimated blood loss parameter in <50 years group had mean 72.85±44.79 ml and ≥ 50 years group had mean 115.00±95.25 ml with p = 0.001 (Table 3). We got strong correlation between operation time and estimated blood loss with r = 0.779 and statistically significant (Table 4).

DISCUSSION

In the world, degenerative lumbar spine disease, e.g. hernia nucleus pulposus, disc degeneration, and lumbar spinal stenosis cause significant disability. This pathology was associated with various clinical symptoms, including pain in lower extremity, weakness, and low back pain in varying severity. This problem can lead reduction in quality of life patients.[1,2]

In our report, 87 patients (70.7%) had pathology in lumbar region. This finding supported by Teraguchi et al.[2] that prevalence of lumbar spine degeneration was 69.1 % in man and 75,8% in women. Other Metanalysis performed by Ravindra et al.[1] incidence of lumbar disc degeneration around 78.7%, exceeds overall lumbar degenerative spine disease (52.0%). Almost all of our patients, had symptoms of neurogenic claudication. Same with Ravindra et al.[1] symptomatic degenerative lumbar spinal stenosis with clinical neurogenic claudication is a frequent source for spinal surgery consultation, which most commonly occurs beyond the fifth decade of life. The overall age of our cases was 52.05 years. In another study, in patients who performed percutaneous endoscopic lumbar discectomy, mean age was 46.72 years. Singh et al. stated that mean age operated patient was 68.33 years.[8]

We analyzed operative outcome with operation time and estimated blood loss parameters. We had high correlation between operation time and estimated blood loss (r = 0.789 with p=0.000). Similar result from Zou et al.[9] that operation time and estimated blood loss had a positive correlation. We got significant difference between patients who had age <50 years and >50 years from estimated blood loss parameter. Estimated blood loss parameter in <50 years group had mean 72.85 ± 44.79 ml and ≥50 years group had mean 115.00 ± 95.25 ml with p=0.001. Patients with similar pre-operative conditions, diagnosis and treatment, with younger age (<50 years) had better outcomes than more than 50 years old.

Open vs endoscopic discectomy

Open discectomy needs an ipsilateral or complete laminectomy, resection of the ligamentum flavum, and discectomy. This procedure had effective and favorable patient-reported outcomes. Although it was effective, it changes the paraspinal muscle structure, soft tissue, bones and ligamentous structure of the affected level. Later on, this process causes epidural fibrosis following spinal surgery by replacement of epidural fat with fibrotic tissues.

Compare to open surgery, Endoscopic discectomy has more advantages. This procedure is possible to minimize bony resection and ligamentous structure disruption while approaching the pathological disc site with a safe surgical window by various techniques. As this techniques evolved, neurosurgeons focus shifted to give better spinal surgical treatment with minimal damage surrounding structure and minimizing recurrence.[10,11]

Compared to open and endoscopic decompression and fusion, complete endoscopic decompression and interbody fusion obtained comparable patient-reported benefits, better facet retention, shorter hospital visits, improved perioperative pain control and reduced infection rates. Through the broad application of open and endoscopic spine decompression and fusion procedure in patients with degenerative spine disorder, there has been a related rise of patients with disorders involving revision surgery. Similarly, the recurrence of prolapsed disk is a common long-term complication of discectomy.[7,11]

Endoscopic spine surgery relies on technological advances. Advances in the optical camera endoscopic system and the advancement of endoscopic equipment and thermal energy distribution methods, such as side-burning lasers and

radiofrequency coagulators, present a double-edged sword. On the one hand, these technical advancements offer a better forum for achieving the goals of endoscopic spinal surgery, but on the other hand, the use of modern technology raises the expense of endoscopic spinal surgery.[3,7,11]

One of the key concepts of endoscopic spine surgery is to reduce collateral injury to surgery. With more practice, and ideally with a magnified vision of the mechanisms in the endoscopic area of operation, complications and tissue trauma associated with spinal surgery will be minimized. These efforts obey the ideals of non-maleficence. The favorable effects of well-executed endoscopic spine surgery are well reported in the literature. With a further understanding of the signs and drawbacks of endoscopy, it would be possible to provide patients with equal and potentially superior findings in a healthy and successful way relative to open surgery.[8,10,11]

CONCLUSION

From standard open spine surgery to endoscopic spine surgery, degenerative spinal disease surgical care has improved. With correct indication, careful diagnosis and good preparation, endoscopic spine surgery will have about as good an outcome as open spine surgery.

In our experience, most patients are operated in lumbal segment. Operation mostly performed are endoscopic discectomy. Patients with lumbal segment, had the oldest mean age. There is correlation between operation time and estimated blood loss. Patients with age <50 years had better outcomes in estimated blood loss during operation.

CONFLICT OF INTEREST

The author declares there is no conflict of interest regarding publication of this article.

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ETHICAL STATEMENT

This research was approved by Ethical Research Committee Universitas Diponegoro/Dr. Kariadi Hospital, Semarang, Indonesia.

AUTHOR CONTRIBUTION

Ajid Risdianto, Happy Kurnia Broto Arianto, Dody Priambada, Muhammad Thohar Arifin, Yuriz Bakhtiar, Krisna Tsaniadi contributes concepts and design of study. Ajid Risdianto, Happy Kurnia Broto Arianto, Dody Priambada, Muhammad Thohar Arifin, Yuriz Bakhtiar, Surya Pratama Brilliantika, Krisna Tsaniadi contribute literature search, data collection, data analysis and statistical analysis. All authors contribute manuscript preparation, editing and review.

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