Biportal Endoscopic Spine Surgery for Single Lumbar Disc Herniation or Lumbar Stenosis: Comparison between right and left side approach of right-handed surgeon

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Purpose: *Aim of the study was to compare the outcomes of the surgical treatment between right sided biportal endoscopic spine surgery (R-BESS) and the left sided biportal endoscopic spine surgery (L-BESS) approach for single-level lumbar disc herniation (LDH) or lumbar spinal stenosis (LSS) of right-handed surgeon.*
Methods: *Retrospective cohort study was conducted in adult patients with single LDH or LSS who underwent biportal endoscopic lumbar discectomy or lumbar stenosis decompression by right-handed spine surgeon between December 2018 and May 2020. The surgical side approaches were chosen according to symptomatic side and the finding from magnetic resonance imaging. Perioperative and post-operative outcomes were evaluated comparison between L-BESS and R-BESS.*
Results: *A total of 51 cases were enrolled, of which female to male ratio was 30:21 Mean age was 40.2±10.8 years. Thirty-one cases underwent L-BESS with the ratio for L-BESS and R-BESS was 1.5:1. L4/5 level was the most common surgical level in both L-BESS and R-BESS approach. The mean operative time (OT), mean estimated blood loss, Oswestry Disability Index (ODI) before and after surgery, back pain evaluated by visual analogue score (VAS) before and after surgery, MacNab criteria for patient satisfactory outcomes, hospital stay, hospital costs and immediate postoperative complication were not significant difference between L-BESS and R-BESS with p=0.77, 0.22, 0.52, 0.08, 0.18, 0.67, 0.82, 0.59, 0.27, and 0.30, respectively.*
Conclusions: *BESS for single LDH or LSS had comparable perioperative and postoperative outcomes between right and left sided approach.*

Keywords: *Biportal endoscopic spine surgery, right-handed surgeon, lumbar spinal stenosis, lumbar disc herniation.*

The Thai Journal of Orthopaedic Surgery: 44 No.3-4: 11-18
Received: *June 30, 2020* ***Revised:*** *July 22, 2020* ***Accepted:*** *August 11, 2020*
Full text. e journal: *http://www.rcost.or.th, http://thailand.digitaljournals.org/index.php/JRCOST*

Introduction

Lumbar disc herniation (LDH) and lumbar spinal stenosis (LSS) are common spinal problems in daily practice. The classical symptom is back pain radiating to leg due to nerve root compression. Treatment is usually conservative treatment, but surgical treatment is required in case of persistent or progressive pain that interrupts normal quality of life or having neurological deficit. The current standard treatment of LDH or LSS is open lumbar microdiscectomy (OLM) or micro decompression with partial laminotomy. However OLM resulted in damage to muscle and soft tissue, subsequently increase risks of post-operative spinal instability and chronic back pain[1].

Currently, the modern technique of endoscopic spine surgery is emerged. Most of the literature describes endoscopic procedures using specialized uniportal endoscopes such as percutaneous endoscopic lumbar discectomy, percutaneous endoscopic interlaminar discectomy[2] and uniportal percutaneous lumbar decompression. However, uniportal limits the motion of the instruments and obscures visualization of the operating field. In addition, the cost of instrument is high. To overcome this limitation, unilateral biportal endoscopic spine surgery or biportal endoscopic spine surgery (BESS) which applies two portals is developed.

An arthroscope as well as conventional spinal instruments are available in most of hospital[3,4] and the technique of biportal surgery is similar to microscopic lumbar discectomy. Moreover, recent study showed that BESS had better results regarding rapid pain recovery, low fentanyl using, and early discharge after surgery when compared with microscopic spine surgery[5]. BESS therefore becomes popular and is used not only for difficult LDH but also for LSS[6]. However, there are some disadvantages of BESS including more difficult on the right-sided approach in right handed surgeon because the working portal is on non-predominated hand subsequently became uncomfortable for the surgeon and might affect the postoperative outcomes including operative time,

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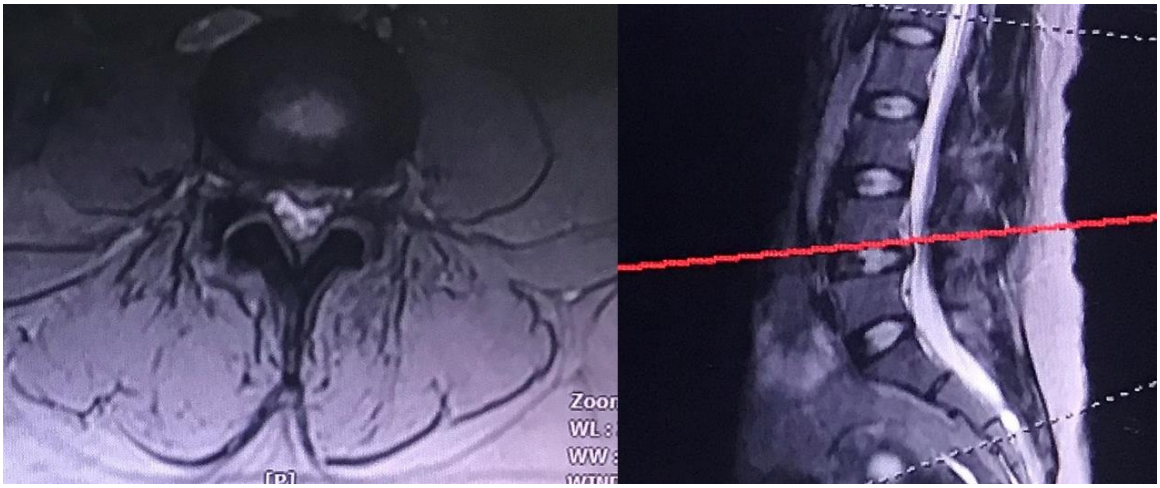
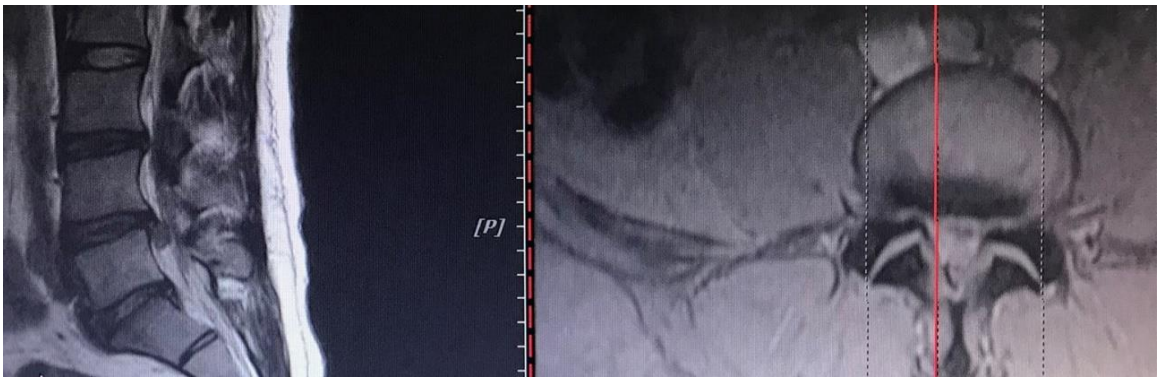
estimated blood loss and/or postoperative complication. The study aims to compare the outcomes in term of operative time, estimated blood loss, back pain evaluated by visual analogue score (VAS) before and after surgery, MacNab criteria for patient satisfactory outcome, hospital stay, hospital costs and postoperative complication between right sided biportal endoscopic spine surgery (R-BESS) and the left sided biportal endoscopic spine surgery (L-BESS) approach for single-level lumbar disc herniation (LDH) or lumbar spinal stenosis (LSS) of right-handed surgeon.

Methods

Historical cohort study was conducted in adult patients with single LDH or LSS who underwent biportal endoscopic lumbar discectomy or lumbar stenosis decompression by right-handed spine surgeon between 28 December 2018 and May 2020. The inclusion criteria included the adult patients with single level LDH or single level LSS by magnetic resonance imaging (MRI) study (Figure 1), having neurologic claudication or radicular leg pain referring to LDH or LSS and persistent or progressive pain which was not respond to conservative treatment for at least 6 weeks. We excluded the patients with spondylolisthesis more than Grade I Mayerding, pregnancy or lactation, previous lumbar surgery, or unfitted medical condition for operation. The operative time, estimated blood loss (EBL), Oswestry Disability Index (ODI), back pain and leg pain evaluated by visual analogue score (VAS) before and after surgery, MacNab criteria for patient satisfactory outcomes, hospital stay, hospital costs and postoperative complication were recorded and evaluated for all enrolled patients. The outcomes of MacNab criteria for patient satisfactory outcomes from the last follow up were evaluated.



(1A) MRI finding for L-BESS approach



(1B) MRI finding for R-BESS approach

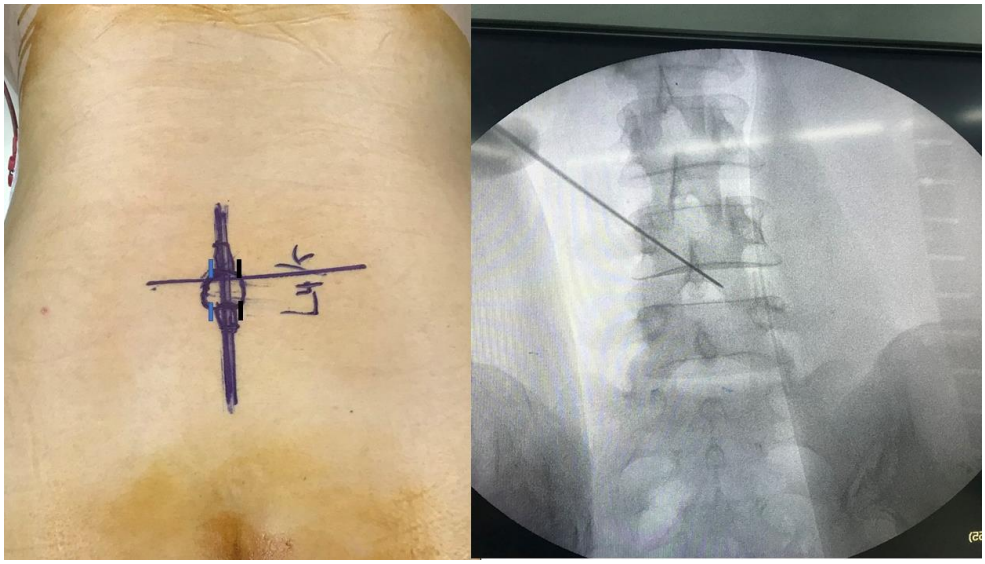
Fig.1 The side of the approach according to MRI study.

Operation technique

After general anesthesia, the patients were positioned prone in a Wilson frame for spine surgery. The operative level was identified with image intensifier and marked with surgical pen for the spinous process, disc level and interlaminar space. The portal landmarks were at the margin of upper and lower lamina about 2 centimeters apart and closed to the spinous process (Figure 2). The side of the approach was chosen according to clinical symptomatic side in concordance with MRI study.

The basic technique of BESS consisted of two portals. One was the scope portal on the left hand and working portal on the right hand in L-BESS (Figure 3), but it was opposite way for the R-BESS which the scope portal was on the right hand and working portal was on the left hand (Figure 4). The surgeon could switch working portal to the other hand, as necessary (Figure 5).

The dilators were applied for dilatation the portal and detachment the paraspinal muscle at interlaminar space. Endoscope portal (upper portal) and working portal (lower portal) were inserted through the two separate skin incision and docked onto the upper lamina. Potential space was created with shaver and Arthrocare™ cautery (level 2). The water pump was set to 30-50 mmHg and the irrigation flow was through the skin portal. Unilateral laminotomy was performed with high speed blur and Kerrison rongeur, ligamentum flavum was remove and Dural sac was exposed. For LDH, the traversing nerve roots were identified and protected with Penfield or semi tubular retractor, Discectomy was done with knife, curettage. Annuloplasty was done by coagulation. For LSS, we performed unilateral approach for bilateral decompression.



L-BESS (blue) demonstrated viewing portal (above) and working portal (below)
R-BESS (black) demonstrated viewing portal (above) and working portal (below)
Fig. 2 Surgical landmark.

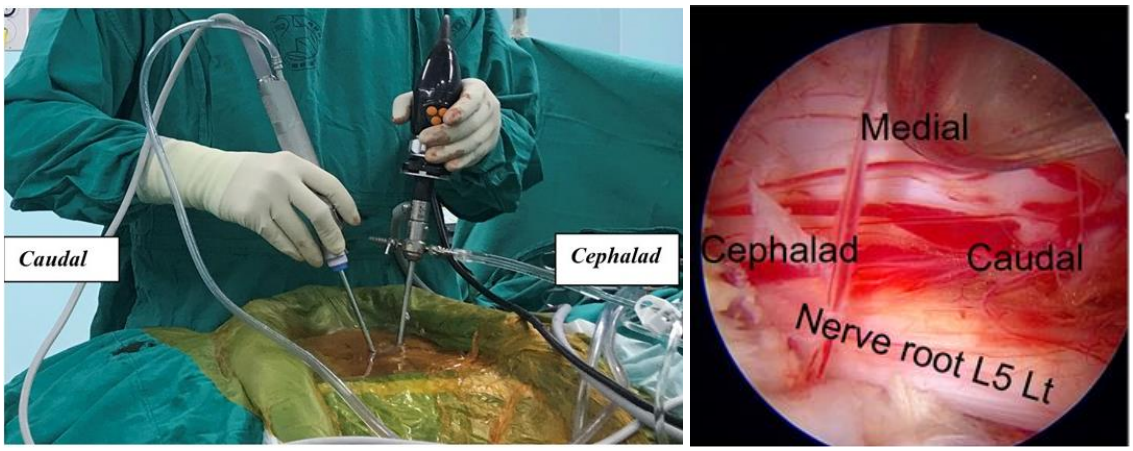


Fig. 3 L-BESS showed the scope portal was on the left hand while working portal was on the right hand.

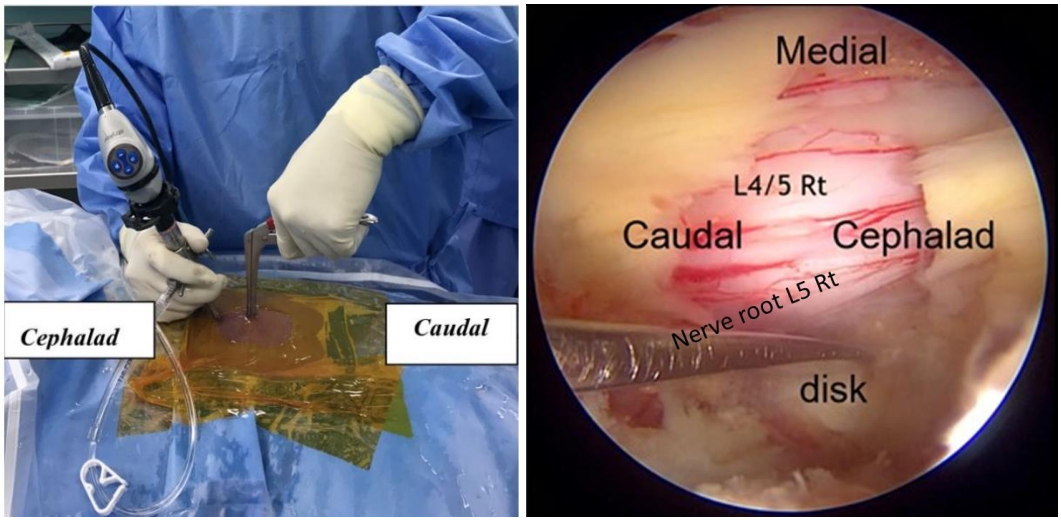


Fig. 4 R-BESS showed the working portal was on the left hand while the scope portal was on the right hand.

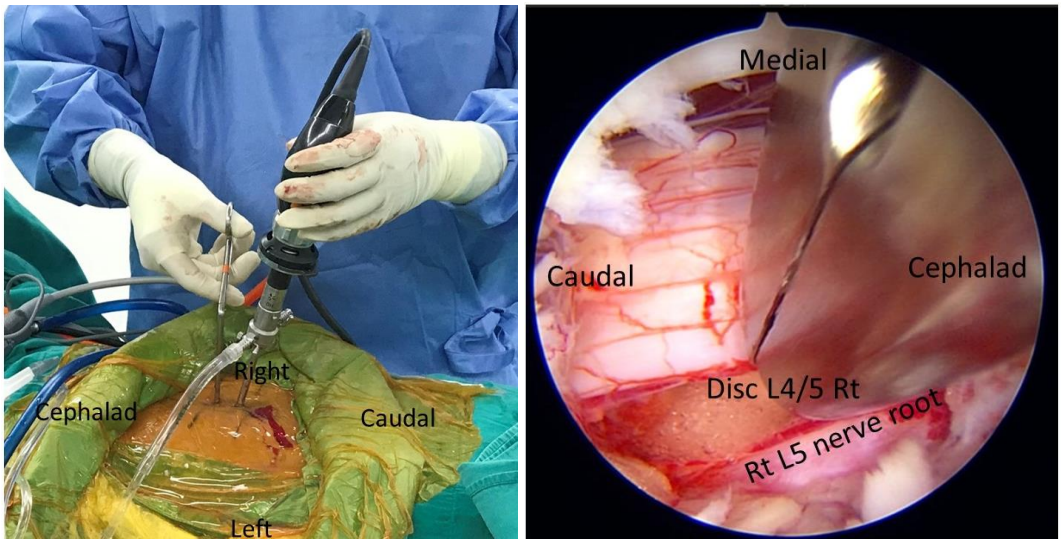


Fig. 5 R-BESS showed the scope portal was on the left hand while the working portal was on the right hand.

After the operation, a redivac drain was placed and the incision was closed. Antibiotic prophylaxis with Cefazolin intravenous for 2 days and the patient was encouraged to ambulate with lumbar support as soon as possible. The patients were called for follow up at 2 weeks, 3 months, and 6 months after surgery.

Statistical Analysis

Patients' baseline characteristics were summarized using descriptive statistic presenting in percentage, mean and standard deviation. The continuous data was analyzed by using unpaired Student's t-test or the Mann–Whitney U test as appropriate. Categorical outcomes were assessed with the Chi-square or Fisher's exact test, where appropriate. The comparison of continuous data between pre- and postoperative outcomes were analyzed by using student's paired t test. All p-values were two-tailed, and statistical significance was regarded as $p<0.05$. All statistics will be analyses by STATA version 16.0 (Stata Corp. College Station, TX, USA).

Ethical consideration

The study was designed by the authors and approved by Institutional Review Board of Khon Kaen Hospital per the Helsinki Declaration and the Good Clinical Practice Guidelines.

Results

A total of 51 patients with single level LDH or single level LSS were enrolled, of which female to male ratio was 30:21. Mean age was 40.2±10.8 years. Thirty-one cases underwent L-BESS and twenty cases underwent R-BESS by right-handed surgeon who had experience for open microscopic discectomy and had some of experience of uniportal

endoscopic spine surgery. L4/5 level was the most common surgical level in both L-BESS and R-BESS approach. Most of the patients in L-BESS approach were discectomy (87%), while all were discectomy in R-BESS approach. The mean age in L-BESS approach was older than in R-BESS approach (43.4±10.2 vs 35.0±9.8; p=0.01). The mean BMI was not different between both groups. Levels of surgical approach were comparable between L-BESS and R-BESS approach. The differences of demographic data between L-BESS and R-BESS approach was revealed and are presented in Table 1.

Perioperative outcomes

Mean OT was not significant difference in L-BESS and R-BESS approach (p=0.77) as well as mean EBL (p=0.22), median surgical drain output (p=0.06) and immediate complication (p=0.30). The OT in decompressive laminectomy was not different from discectomy (92.2 vs 102.3 minutes p=0.50). The perioperative outcomes between L-BESS and R-BESS are presented in Table 1.

Post-operative outcomes

Total mean of follow up time was 6.5±3.7 months, with mean follow up in L-BESS was 6.5±3.5 months and R-BESS 6.5±4.1 months. ODI score as well as back and leg pain were significant improvement after surgery in both groups when compare to prior surgery (Table 2) but it was not different between L-BESS and R-BESS approach (Table 1.). MacNab criteria for patient satisfactory outcome was overall improved to good result 86.2%, excellent result 9.8% and fair result 4%. The mean hospital stays and hospital costs was not different between L-BESS and R-BESS approach (Table 1).

There are 3 complications in R-BESS group, first case was the red screen (the visual field was obscured by bleeding) thus converted to open surgery. Other two cases were wrong level surgery that needed portal extensions. L-BESS had 2 complications, first case had immediate postoperative epidural hematoma and prolong length of stay to 20 days, another case was inadequate disc removal. Both cases underwent revision surgery later. All cases with complication had clinical improvement and were discharged.

Table 1 Demographic data and outcomes comparison between L-BESS and R-BESS.

Data	L-BESS	R-BESS	*P*-value
Sex female (%)	20 (64)	10 (50)	0.30
male (%)	11 (36)	10 (50)	
Age (years); mean±SD	43.4±10.2	35.0±9.8	0.01*
BMI (kg/m^2); mean±SD	25.5±4.5	24.3±3.6	0.31
Surgical Level			0.97
L4/5 (%)	16 (52)	10 (50)	
L5/S1 (%)	13 (42)	8 (40)	
L2/3 (%)	1 (3)	1 (5)	
L3/4 (%)	1 (3)	1 (5)	
Discectomy (%)	27 (87)	20 (100)	0.10
Stenosis decompression (%)	4 (13)	0	
Preoperative data			
ODI (unit); mean±SD	74.4±10.3	76.5±13.5	0.52
VAS of back pain; mean±SD	6.3±2.6	5.2±3.1	0.18
VAS of leg pain; mean±SD	8.4±1.3	8.7±1.0	0.43
Perioperative outcomes			
Operative time (minutes); mean±SD	100.5±27.9	103.1±33.6	0.77
Estimated blood loss (ml); mean±SD	31.7±27.0	42.5±35.7	0.22
Postoperative outcomes			
Surgical drain output (ml); median (IQR)	90 (60-130)	45 (0-130)	0.06
Immediate complication (%)	2 (6.5)	3 (15)	0.30
Hospital stay (day); mean±SD	5.4±5.0	4.8±2.3	0.59
Hospital costs (Baht); mean±SD	44,042±17,277	39,291±9,488	0.27
ODI; mean±SD	18.7±13.5	12.7±8.2	0.08
VAS of back pain; mean±SD	2.1±1.9	1.9±1.1	0.67
VAS of leg pain; mean±SD	2.2±1.9	1.8±1.2	0.39
MacNab criteria			0.82
Excellent (%)	3 (10)	2 (10)	
Good (%)	26 (84)	18 (90)	
Fair (%)	2 (6)	0	

*statistically significant

L-BESS left sided biportal endoscopic spine surgery; R-BESS right sided biportal endoscopic spine surgery; BMI body mass index; SD standard deviation; ODI Oswestry Disability Index; VAS visual analogue score; IQR interquartile range

Table 2 The changing of ODI and pain score when compare to prior surgery stratified by sided approach.

Data	Before surgery	After surgery	Mean difference	*P*-value
L-BESS				
Changing of ODI; mean±SD	74.4±10.3	18.7±13.5	55.7±16.4	<0.001*
Changing of VAS for back pain; mean±SD	6.3±2.6	2.1±1.9	4.2±2.7	<0.001*
Changing of VAS for leg pain; mean±SD	8.4±1.3	2.2±1.9	6.2±2.5	<0.001*
R-BESS				
Changing of ODI; mean±SD	76.5±13.5	12.7±8.2	63.8±8.2	<0.001*
Changing of VAS for back pain; mean±SD	5.2±3.1	1.9±1.1	3.3±3.0	<0.001*
Changing of VAS for leg pain; mean±SD	8.7±1.0	1.8±1.2	6.9±1.5	<0.001*

*statistically significant

L-BESS left sided biportal endoscopic spine surgery; R-BESS right sided biportal endoscopic spine surgery; SD standard deviation; ODI Oswestry Disability Index; VAS visual analogue score

Discussion

Emerging of endoscopic spine surgery has been driven due to the increasing number of surgical treatment selection by the patients but the cost of endoscopic spine surgery is very high and causes a budget burden particularly the government hospital. BESS has many advantages not only low cost of treatment but also wide range of movement of the instrument.

The present study demonstrated no difference of perioperative outcomes (OT and EBL), postoperative outcomes (immediate complication, the pain score assessed by VAS, hospital cost and length of stay) between L-BESS and R-BESS approach. L-BESS and R-BESS approach had comparable surgical outcomes, so either L-BESS or R-BESS approach can be a choice of operation for the adult patients with single level LDH or single level LSS who need or require minimal invasive spine surgery.

We did the analysis of the initial 16 enrolled cases and found that L-BESS approach had less OT and EBL than in R-BESS approach but the mean surgical drain output and length of stay was not different (poster presentation at RCOST 2019). The findings reflect that the operative approach particularly R-BESS needs learning experience at the initial step and then the outcomes however were acceptable after that.

The range of mean operative time by BESS technique was reported around 68.0-89.1 minutes in LDH and 58.0-110.4 minutes in LSS[7,8]. Our OT in lumbar discectomy (102.3 minutes) by BESS technique was a little longer than previous studies but OT in LSS (92.2 minutes) by BESS technique was comparable with previous studies. The findings might explain by the limitation of special surgical instrument and surgical technique. To date, no study reports the comparison of OT time between L-BESS and R-BESS. Our study revealed slightly longer OT in R-BESS over against L-BESS approach, however, there was no significant difference of OT between L-BESS and R-BESS.

BESS technique is a viable option of LDH and LSS in an obese patient. Most of the patients were overweight (BMI≥25 kg/m^2) but BESS in both L-BESS and R-BESS approach showed good results and outcomes because BESS had the advantage in clear vision even in obese patient. Moreover, the efficacy of BESS in LDH or LSS were confirmed by the improvement of ODI, postoperative pain and patient satisfactory in both L-BESS and R-BESS approach with acceptable rate of postoperative complication.

This study has some limitations including; a) the data was limited by the nature of the retrospective study; anyway perioperative outcomes were available in every case in the study; b) postoperative pain evaluation was not evaluated by a single assessor; and c) there is a selection bias of choosing surgical sided approach at the initial of study due to uncomfortable surgical approach, so confounders would be occurred and unavoidable. However, the demographic data of both L-BESS and R-BESS were not different except the older age group among L-BESS over against R-BESS. The strength of the study is we included the interested parameter outcomes not only related to the outcomes of surgery but also related to public health consideration particularly hospital stay, hospital costs and MacNab criteria for patient satisfactory outcomes. Even these preliminary findings can provide the information for the right-handed attending surgeons and can be used as guides to consider using the surgical technique and planning the better care as appropriate.

Conclusions

L-BESS is more common approach than R-BESS for single-level lumbar disc herniation or lumbar spinal stenosis but has comparable perioperative and postoperative outcomes.

Declaration

Conflict of interest

The author has no conflict of interest.

Author contributions

TF designed the study, did data collection, drafted the manuscript, and proofread the manuscript.

Acknowledgement

The author would like to thank Professor Chingching Foocharoen for her assistant in statistical analysis.

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การผ่าตัดส่องกล้องกระดูกสันหลังในผู้ป่วยหมอนรองกระดูกสันหลังส่วนเอวเคลื่อน หรือ ช่องไขสันหลังตีบระดับเดียวด้วยเทคนิค 2 ช่องทางเปรียบเทียบระหว่างการผ่าตัดด้านซ้ายและการผ่าตัดด้านขวาในศัลยแพทย์ที่ถนัดขวา

ธนิต ฟูเจริญ, พบ

วัตถุประสงค์: *เพื่อเปรียบเทียบผลของการผ่าตัดส่องกล้องกระดูกสันหลัง ด้วยเทคนิค 2 ช่องทาง ในผู้ป่วยหมอนรองกระดูกสันหลังส่วนเอวเคลื่อน หรือช่องไขสันหลังตีบระดับเดียว ระหว่างข้างซ้ายและข้างขวาในศัลยแพทย์ที่ถนัดขวา*

วัสดุและวิธีการ: *เป็นการศึกษาในผู้ป่วยโรคหมอนรองกระดูกสันหลังส่วนเอวเคลื่อน หรือช่องไขสันหลังตีบระดับเดียว ที่ได้รับการผ่าตัด โดยวิธีส่องกล้องกระดูกสันหลัง ด้วยเทคนิค 2 ช่องทาง ตั้งแต่เดือน ธันวาคม 2561 ถึง พฤษภาคม 2563 โดยเลือกข้างที่จะทำขึ้นอยู่กับพยาธิสภาพที่เป็นจากอาการ และ MRI spine*

ผลการศึกษา: *ผู้ป่วยทั้งหมด 51 คน เป็นผู้หญิงต่อผู้ชาย 30:21 อายุเฉลี่ย 40.2±10.8 ปี ได้รับการผ่าตัดโดยวิธีส่องกล้องกระดูกสันหลัง ด้วยเทคนิค 2 ช่องทาง โดยแบ่งเป็นข้างซ้าย 31 คน และข้างขวา 20 คน ซึ่งส่วนใหญ่เป็นระดับ L4/5 ผลการศึกษาพบว่าระยะเวลาผ่าตัด, การสูญเสียเลือดในระหว่างผ่าตัด, คะแนน ODI ก่อนและหลังผ่าตัด, อาการปวดหลัง ก่อนและหลังผ่าตัด, ความพึงพอใจของผู้ป่วย, ระยะเวลานอนโรงพยาบาล, ค่าใช้จ่ายในการนอนโรงพยาบาล ตลอดจนภาวะแทรกซ้อนหลังผ่าตัดไม่ต่างกันในข้างซ้ายเมื่อเทียบกับข้างขวา (p=0.77, 0.22, 0.52, 0.08, 0.18, 0.67, 0.82, 0.59, 0.27, และ 0.30 ตามลำดับ)*

สรุป: *การผ่าตัดส่องกล้องกระดูกสันหลังในผู้ป่วยหมอนรองกระดูกสันหลังส่วนเอวเคลื่อน หรือ ช่องไขสันหลังตีบระดับเดียวด้วยเทคนิค 2 ช่องทาง เปรียบเทียบระหว่างการผ่าตัดด้านซ้ายและการผ่าตัดด้านขวาในศัลยแพทย์ที่ถนัดขวา พบว่าผลของการผ่าตัดทั้งระหว่างการผ่าตัด และหลังผ่าตัดไม่แตกต่างกัน*