

other case of spontaneous CSF leak, 4 leakage sites were suspected; patient underwent 4 epidural blood and fibrin glue patches at various levels between T1 and L4, with none of which was successful in controlling the symptoms. Again, a PICC line inserted at L3/4 level was navigated to the cranio-cervical junction followed by fibrin glue injection in the epidural space from the cranio-cervical junction down to the upper lumbar level. The procedure was successful in achieving symptoms resolution. No post-procedure complications occurred in both patients.

**Conclusions** Epidural Fibrin glue injection using peripherally inserted central catheter (PICC) lines is a safe and effective approach for treatment of refractory CSF leaks with multiple or unconfirmed sites of leakage.

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#### E-143 EMBOLIZATION OF SPINAL DURAL ARTERIOVENOUS FISTULA: NBCA IS SUPERIOR TO ONYX EMBOLIZATION

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**Introduction/Purpose** Historically, spinal dural arteriovenous fistulas (SDAVFs) have been treated with intradural ligation of the draining vein. While endovascular embolization can achieve durable occlusion in a subset of these patients, recent studies have demonstrated a superiority of microsurgical ligation. However, given that spinal angiography is essential in the workup of suspected SDAVFs, we and others have demonstrated the utility of an 'endovascular-first' approach to SDAVFs. One limiting factor to the success of endovascular therapies has been the reliability of casting and occluding the draining vein using Onyx. In contrast, we have observed that n-butyl-2-cyanoacrylate (NBCA) glue can readily penetrate and cast the fistula and vein. We therefore sought to compare the efficacy of NBCA and Onyx embolization in the treatment of SDAVFs.

**Material and Methods** We performed a retrospective analysis of our endovascular database from 4/2007 to 4/2019 to identify patients treated for SDAVFs. We extracted demographic, clinical, treatment, and radiographic information data. We considered a 'durable cure' of the SDAVF to include complete obliteration of the fistula following endovascular treatment, demonstrated clinical improvement, and follow-up radiographic studies demonstrating improvement of spinal cord edema and flow voids on MRI/MRA and/or persistent obliteration on follow-up angiograms. We compared our results using Onyx and NBCA embolysate.

**Results** We performed 40 endovascular treatments for SDAVFs in 38 patients. The embolysates utilized were Onyx without any other embolysate (22), NBCA without any other liquid embolysate (16), and a combination of NBCA and Onyx (2). For the 22 treatments in which Onyx was the only embolysate used, endovascular treatment resulted in a durable cure in 11 cases (50%) (mean follow-up 20.8 months). For 10 of these 22 (45.5%), a complete obliteration of the fistula with casting of the vein was not achieved and these patients were referred for microsurgical ligation. For 1 of these 22 treatments, a complete obliteration of the fistula was noted on immediate post-procedure angiography. However, 4.2 months

after treatment, he was found to have a recurrence. For the 16 treatments in which NBCA was the only liquid embolysate used, endovascular treatment resulted in a complete obliteration of the fistula following treatment in all 16 (100%) patients. None of these patients underwent subsequent microsurgical treatment. Follow-up data were available for 13 of these patients (81.3%). Of these 13, all (100%) achieved a durable cure (mean follow-up 19.6 months) without clinical or radiographic recurrence. A durable cure was achieved more frequently in patients treated with NBCA (100%) relative to those treated with Onyx only (50%) ( $p < 0.01$ ). We evaluated the fluoroscopy time used in cases where obliteration of the fistula was achieved using a single radicular artery and resulted in a durable cure. When Onyx was used, the mean fluoroscopy time was 50.8. In contrast, the mean fluoroscopy time was significantly shorter ( $P < 0.02$ ) when NBCA was used for these cases (mean 31.8 minutes).

**Conclusion** NBCA embolization of SDAVFs is superior to Onyx embolization. NBCA embolization is safe and effective for a subset of SDAVFs with results in this population comparable to microsurgical ligation.

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#### E-144 MINIMALLY INVASIVE SCOLIOSIS SURGERY WITH TRANS KAMBIN POSTERIOR OBLIQUE LATERAL LUMBAR INTERBODY FUSION: SINGLE SURGEON FEASIBILITY STUDY

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**Background** Degenerative deformities of the spine have traditionally been treated with extensive open surgeries. However, these open procedures are associated with a high degree of surgical morbidity. In this study, we explore whether clinical improvement in patients with spinal deformities can be achieved using a new minimally invasive surgery (MIS) called oblique lateral lumbar interbody fusion (OLLIF). OLLIF is a MIS single surgeon procedure in which the disc is approached through Kambin's triangle. OLLIF can achieve correction of spinal deformities through careful cage placement.

**Purpose** The purpose of this study is to establish the safety and efficacy of using OLLIF to correct spinal deformities and to collect early outcome data. Collected data includes perioperative outcomes, patient reported outcomes, and radiographic outcomes.

**Study Design/Setting** This study is a retrospective review of 37 OLLIF surgeries in 36 patients with symptomatic degenerative spinal deformity. Collected perioperative data included surgery time, blood loss, and hospital stay. Follow-up was conducted at least 150 days post surgery. We recorded complications and patient reported outcomes such as Oswestry Disability Index (ODI) and pain scale. Imaging was conducted pre- and post-surgery. Fusion rates and changes in Cobb angle were also measured.

**Results** A total of 37 surgeries that treated 100 vertebral levels were performed. For two and three level procedures, respectively, the mean blood loss was 83 and 178 ml, the average surgery time was 74 and 158 minutes and the

average hospital stay was 2.6 and 3.3 days. The patients ambulated within 24 hours in all but two cases. The patients reported pain improvements on the ten-point pain scale from 8.3 to 3.7 ( $p < 0.001$ ) and on the ODI from 53% to 32%. Cobb angles decreased from  $16^\circ$  to  $9.3^\circ$  ( $p < 0.001$ ), amounting to  $2.5^\circ$  of correction per level of surgery. Detailed imaging was reviewed by independent radiologists for 24 cases and 100% interbody fusion was achieved along with 71% right posterolateral and 74% left posterolateral fusion. There were three cases of mild nerve irritation/neuropraxia and no infections.

**Conclusions** OLLIF is a safe and effective MIS technique to correct adult degenerative scoliosis. Unlike alternative procedures, OLLIF is technically less complex than comparable procedures and can safely be used from the thoracolumbar junction to S1.

**Disclosures** H. Abbasi: None.

E-145

#### MINIMALLY INVASIVE SCOLIOSIS SURGERY WITH TRANS-KAMBIN POSTERIOR OBLIQUE LATERAL LUMBAR INTERBODY FUSION: SINGLE SURGEON FEASIBILITY STUDY

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**Objectives** Between 1998 and 2008 the number of spinal fusions in the U.S. increased 2.4 fold and the cost per fusion increased 3.3 fold, leading to a 7.9 fold increase in the cost burden of spinal fusions to the U.S. health care system. OLLIF is a new minimally invasive procedure for fusions of the Lumbar spine that can be employed safely and effectively from T12-L1 to L5- S1. OLLIF approaches the disk space through Kambin's triangle. OLLIF does not require direct visualization but instead relies on bilateral fluoroscopic imaging and electrophysiological monitoring. OLLIF reduces surgery times and hospital stay compared to TLIF. The purpose of this study is to evaluate the preoperative cost of OLLIF compared to TLIF.

**Materials and Methods** The study population are 69 OLLIF patients and 58 open TLIF controls. All patients underwent full course of conservative therapy. Indications were Degenerative Disk Disease, Disk Herniation, Listhesis, Stenosis (except Osteogenic Stenosis). This is a retrospective cohort study. All surgeries were single surgeon procedures and all TLIF cases were completed before the surgeon started performing OLLIF. We recorded surgery time, length of stay and infection rates. Perioperative outcomes were monetized by using a multiplier approach. OR Time was monetized at \$ 83.51/minute and hospital stay at \$ 2197/day. Infection rate was monetized relative to a 2.4% infection rate for open procedures.

**Results** OLLIF cuts surgery times and hospital stay in half relative to TLIF (59/132 min, 4.7/2.3 days respectively). When these differences are monetized, OLLIF reduces the average cost per surgery relative to TLIF by \$11,834 per surgery, with higher cost reductions for multi-level procedures. In over 500 OLLIF procedures to date, there have been no deep infections requiring drainage and only a single superficial infection (0.2%). We estimate that the reduction in infections saves an additional \$316 per surgery, for a total cost reduction of \$12,150.

**Discussion** In 2008, there were 207,495 lumbar fusions in the U.S. [1]. By saving \$12,150 per surgery relative to the current standard of care, OLLIF could reduce U.S. healthcare expenditures by over \$2.5bn. We are currently conducting a detailed study of the costs of OLLIF relative to TLIF. This study will include direct health care costs such as provider visits, injections, diagnostic tests, medication, and devices, as well as indirect health costs and productivity losses due to disability.

**Conclusions** OLLIF is a new MIS spinal fusion that reduces perioperative costs relative to open surgery and could potentially reduce U.S. healthcare expenditures by \$2.5bn per year, through the preoperative cost savings alone. A comprehensive cost analysis is under way.

**Disclosures** H. Abbasi: None.

E-146

#### MINIMALLY INVASIVE DIRECT LATERAL INTERBODY FUSION (MIS-DLIF): PROOF OF CONCEPT AND PERIOPERATIVE RESULTS

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**Background** Minimally invasive direct lateral interbody fusion (MIS-DLIF) is a novel approach for fusions of the lumbar spine. In this proof of concept study, we describe the surgical technique and report our experience and the perioperative outcomes of the first nine patients who underwent this procedure.

**Study Design/Setting** In this study we establish the safety and efficacy of this approach. MIS-DLIF was performed on 15 spinal levels in nine patients who failed to respond to conservative therapy for the treatment of a re-herniated disk, spondylolisthesis, or other severe disk disease of the lumbar spine.

**Outcome Measures** We recorded surgery time, blood loss, fluoroscopy time, patient-reported pain, and complications.

**Methods** Throughout the MIS-DLIF procedure, the surgeon is aided by biplanar fluoroscopic imaging to place an interbody graft or cage into the disc space through the interpleural space. A discectomy is performed in the same minimally invasive fashion. The procedure is usually completed with posterior pedicle screw fixation.

**Results** MIS-DLIF took 44/85 minutes, on average, for 1/2 levels, with 54/112 ml of blood loss, and 0.3/1.7 days of hospital stay. Four of nine patients did not require overnight hospitalization and were discharged two to four hours after surgery. We did not encounter any clinically significant complications. At more than ninety days post surgery, the patients reported a statistically significant reduction of 4.5 points on a 10-point sliding pain scale.

**Conclusions** MIS-DLIF with pedicle screw fixation is a safe and clinically effective procedure for fusions of the lumbar spine. The procedure overcomes many of the limitations of the current minimally invasive approaches to the lumbar spine and is technically straightforward. MIS-DLIF has the potential to improve patient outcomes and reduce costs relative to the current standard of care and therefore warrants further investigation. We are currently expanding this study to a larger cohort and documenting long-term outcome data.

**Disclosures** H. Abbasi: None.