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Clinical Study

Complications of open compared to minimally invasive lumbar spine decompression

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ABSTRACT

Minimally invasive modalities have demonstrated efficacy in the treatment of neurogenic claudication. Direct comparisons, however, between complication rates of these newer techniques with open surgical techniques for lumbar decompression are lacking. This single-institution study examined neurogenic claudicants between August 2007 and June 2009. A total of 26 patients received open surgical decompression, and 23 patients microendoscopic decompression. Baseline demographic characteristics, perioperative morbidity and mortality, length of hospital stay, and final disposition following hospitalization were recorded. Morbidity was divided into major and minor categories as defined by degree of requisite intervention and adverse impact on hospital stay. Average age, number of surgical levels, and pre-operative American Society of Anesthesiologists Physical Status Index scores were similar in each group ($p > 0.05$). While minimally invasive surgery may be associated with slightly longer operative times, there is decreased blood loss, shorter hospital stays, and likely decreased requirements for ancillary support services upon discharge.

1. Introduction

Lumbar stenosis can produce a debilitating condition in older adults, resulting in significant morbidity and impairment of daily activities. Medicare reported in 2007 that 37,598 people in the United States had been diagnosed with, and surgically treated for, lumbar stenosis.[1] Classically, surgical decompression involves a midline incision with periosteal dissection of paraspinal musculature from the spinous processes and lamina, with removal of the bony elements and underlying ligamentum flavum. Minimally invasive spine surgery (MIS) has evolved rapidly since the late 1990s. Minimally invasive approaches have been reported to be as successful as open techniques at lumbar decompression with less disruption of surrounding soft tissue structures.[2] Recently, comparative studies have reported less operative blood loss and shorter hospitalizations for patients undergoing minimally invasive lumbar decompressions compared to open laminectomies.[3,4] Furthermore, overall improvements in clinical outcomes have been observed for patients undergoing minimally invasive decompressions.[5–7] Medical complications are not uncommon in older patients undergoing lumbar decompression. To date, there is a paucity of data on complications that are associated with minimally invasive decompression, and no reports that have included focused comparisons of complications to open approaches.[8]

2. Methods

Approval was obtained from the Institutional Review Board for a retrospective chart review of all patients with lumbar decompression performed by a single institutional department at an academic teaching hospital between August 2007 and June 2009. All patients enrolled in the study had symptomatic neurogenic claudication, and underwent either a 1-level or 2-level lumbar decompression for degenerative lumbar stenosis (open compared to MIS). All MIS procedures were performed by the senior author (R.G.F.). Six other surgeons were involved in performing the open lumbar decompression. Patients who had undergone resection of synovial cysts, excision of herniated discs, resection of associated spinal tumors, or had received prior lumbar spine surgeries were excluded from the study.

Information on the average age, gender, number of operative levels, and medical complications were recorded. Surgical risk factors and co-morbidities were identified by the anesthesiologist of record preoperatively, and then stratified using the universal American Society of Anesthesiologists Physical Status Index (ASA classification). According to the ASA classification system, Class 1 patients are considered healthy. ASA Class 2 patients have mild to moderate systemic disease that may not be related to the reason

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for the surgery. ASA Class 3 patients have severe systemic illness that may or may not be related to the reason for surgery. ASA Class 4 patients have severe systemic co-morbidities that are life threatening with or without surgery. ASA Class 5 patients are moribund and have little chance of survival but receive surgery strictly as a palliative measure.

For each patient who underwent microendoscopic decompression of stenosis (MEDS), general anesthesia was performed, and the patient was placed prone on a Wilson frame. The skin was prepped and draped in a sterile fashion. Under fluoroscopic guidance, the level of stenosis was identified and marked 1.5-cm lateral to the midline. This area was infiltrated with 0.5% Marcaine with epinephrine. A stab incision was made through which a Steinmann pin was advanced to the facet at the level of stenosis and confirmed fluoroscopically. The incision was then extended 2 cm. A series of dilators were placed over the Steinmann pin and the Steinmann pin was removed. The working channel was positioned, locked in place, and confirmed fluoroscopically. An endoscopic camera was then introduced into the working channel. Electrocautery was utilized to remove any soft tissue remaining in the working channel. An angled curette was employed to define the sublaminar plane. A hemilaminectomy was performed with a Kerrison punch at the level of the stenosis. This was extended to a medial facetectomy using a high-speed drill. A Kerrison punch was used to remove any residual, bony ledge. The tube was then angled to the contralateral side and the drill was used to shave the ventral surface of the spinous process and contralateral lamina with extension to the contralateral pedicle. An angled curette was then used to define the plane between the ligamentum flavum and the dura. The ligamentum flavum was removed using a Kerrison punch. At completion of the decompression, the dura was decompressed bilaterally from the bottom of the superior pedicle to the middle of the inferior pedicle. The wound was then copiously irrigated with antibiotic solution. Hemostasis was obtained with a combination of bipolar electrocautery, thrombin-soaked gelfoam, and absorble gelatin powder. The retraction apparatus was then removed, the fascia was closed using 0-Vicryl (polyglactin 910; Ethicon, New Brunswick, NJ, USA) stitches, and subcutaneous tissues were closed using 2-0 Vicryl stitches. Finally, the skin was closed using topical skin adhesive. In two-level decompressions, the skin incision was centered between the two stenotic loci, and the tube was directed cephalically and caudally as needed. Cerebrospinal fluid (CSF) leaks, when they occurred, were managed with the application of dural sealant inside the tubular retractor over the dural defect. Patients were then kept flat overnight.

Open lumbar decompressions were also performed under general anesthesia. Patients were placed prone on a Wilson frame. The lumbo-sacral portion of the back was prepped in a sterile fashion. A linear incision was made overlying the spinous processes of the desired levels and verified with intra-operative radiography. A bilateral, periosteal dissection of the paravertebral muscles was performed. McCulloch retractors were used to provide retraction. The spinous processes of the affected levels were amputated with a Leksell rongeur and an angled bone cutter. The lamina was further removed with a high-speed drill, and the laminectomy was completed utilizing Kerrison rongeurs. The ligamentum flavum was removed with a series of Kerrison rongeurs. A neural probe was placed on either side of the dura to ensure that the lateral recesses were not stenotic. Hemostasis was obtained with bipolar electrocautery, thrombin-soaked gelfoam, and absorble gelatin powder. A subfascial drain was left in place at the surgeon's discretion and was tunneled through a separate stab incision. The fascia was closed with 0-Vicryl, followed by 2-0 Vicryl for the subcutaneous tissue, and 3-0 Vicryl to approximate the skin edges. Staples were used to provide additional reinforcement to the skin edges. If an unintentional durotomy resulted in a visible intra-operative CSF leak, a primary repair was performed using 4-0 non-absorbable, interrupted sutures (with or without fat graft and dural sealant). If an obvious dural defect was not apparent, but CSF egression from the margins of the thecal sac was observed, then a dural sealant was applied. For large defects, a lumbar drain was placed after primary closure of the durotomy. Patients were kept flat post-operatively at the discretion of the surgeon.

Demographic information was recorded for both open and MIS surgical groups. Surgical parameters were also recorded during the operation including the length of surgery, the presence of an intra-operative CSF leak, and estimated blood loss. The post-operative course was reviewed and complications were categorized. Post-operative complications were divided into mortality and major and minor morbidity. Major morbidity included pulmonary embolism, myocardial infarction, respiratory distress requiring re-intubation, acute renal failure requiring dialysis, cerebrovascular event, or any new cardiac arrhythmia. A minor morbidity was defined as urinary retention, urinary tract infection, deep vein thrombosis, prerenal azotemia, acute renal insufficiency, pneumonia, respiratory stridor, wheezing, asymptomatic desaturations, or delirium. Other surgical complications were documented including wound infections and cerebrospinal fluid leaks. Length of hospital stay and transfers to rehabilitation or skilled nursing facility transfers were tabulated for all patients. Discharge from the hospital was contingent upon patient progression with physical and occupational therapy, pain control, and medical clearance.

All data were analyzed using Microsoft Excel 12.2.6 (Microsoft Corporation; Redmond, WA, USA) and StatPlus 5.8.3.5 (AnalystSoft, Vancouver, BC, Canada). Where assumptions of normality, homoscedasticity, and independence were valid for each variable of interest, comparisons were made between open and MIS groups with two-tailed Student's *t*-tests. Two variables of interest (estimated blood loss, length of hospital stay) violated normality assumptions (D'Agostino Omnibus test), and in these instances a non-parametric test for independent samples was utilized (Mann–Whitney *U*-test). In all instances, an alpha level <0.05 was considered statistically significant.

3. Results

Baseline characteristics for patients in both open and microendoscopic lumbar decompression groups are presented in Table 1. Both groups had patients of similar age ($mean_{open}$ = 64.5 years, standard deviation $[SD]_{open}$ = 11.3 years, $mean_{MIS}$ = 69.1 years, SD_{MIS} = 10.3 years, p = 0.144). The open group had significantly more men than the MIS group ($males_{open}$ = 46.1%, $males_{MIS}$ = 78.2%, p = 0.021). On average, both groups had a similar number of surgical levels ($mean_{open}$ = 1.42, SD_{open} = 0.50, $mean_{MIS}$ = 1.35, SD_{MIS} = 0.49, p = 0.598). Patients in both groups had similar pre-operative health status and risk factors as designated by the pre-operative ASA scores ($mean_{open}$ = 2.34, SD_{open} = 0.49, $mean_{MIS}$ = 2.26, SD_{MIS} = 0.45, p = 0.530).

Intra-operative factors were also documented for both groups (Table 2). Operative duration approached statistical significance

Table 1
Characteristics of patients undergoing open compared to minimally invasive spine surgery (MIS) lumbar decompression

Characteristics	Open (n = 26)	MIS (n = 23)	p-Value
Age (years, mean, SD)	64.5 (11.3)	69.1 (10.3)	0.144
Male (n/N, %)	12/26 (46.1)	18/23 (78.3)	0.021
Operative levels (no., mean, SD)	1.42 (0.50)	1.34 (0.49)	0.560
ASA class (mean, SD)	2.34 (0.49)	2.26 (0.45)	0.530

ASA = American Society of Anesthesiologists Physical Status Index; SD = standard deviation.