Lumbar Catheter Placement Using Paramedian Approach Under Fluoroscopic Guidance

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Abstract

Background—Lumbar catheter placement under fluoroscopic guidance may reduce the rate of technical failures and associated complications seen with insertion guided by manually palpable landmarks.

Methods—We reviewed our experience with 43 attempted lumbar catheter placements using paramedian approach under fluoroscopic guidance and ascertained rates of technical success, and clinical events.

Results—Among the 43 patients, 18, 1, and 1 patients were on aspirin (with dipyrimadole in 2), clopidogrel, and combination of both, respectively. Lumbar catheter placement was successful in 42 of 43 attempted placements. Floroscopy guidance was critical in three patients; one patient had severe cerebrospinal fluid (CSF) depletion (empty thecal sac phenomenon) following pituitary surgery leading to no cerebrospinal fluid return despite correct placement confirmation under fluoroscopy. Two patients had spinal needle placement at the junction between epidural and cerebrospinal fluid spaces (junctional position) leading to cerebrospinal fluid return but inability to introduce the lumbar catheter. After confirmation of position by the injection of contrast or radiographic landmarks the needle was advanced by indenting the subcutaneous tissue or reinserting at a spinal level above the first insertion. The lumbar catheter remained in position over a mean period (±standard deviation) of 4.1(±2.3) days. Improvement in hydrocephalus was seen in two patients with intracranial mass lesions. One patient developed cerebrospinal fluid leakage through the insertion track following removal of catheter and required skin suturing at the site of insertion.

Conclusions—We observed a high technical success rate with low rate of complications even in patients with intracranial mass lesions, those on ongoing antiplatelet medications or in whom insertion would not be possible guided by manually palpable landmarks.

Keywords
Lumbar catheter; hydrocephalus; fluoroscopy; spinal needle; cerebrospinal fluid

Introduction

Lumbar catheter drainage is a procedure consisting of external drainage of cerebrospinal fluid using a catheter placed through the lumbar vertebral interspace into the subarachnoid space. The procedure has been used for prevention and treatment of spinal cord ischemia in patients undergoing thoracoabdominal aortic aneurysm repair [1,2], those with communicating hydrocephalus [7,8] and idiopathic intracranial hypertension [9,10] to assess the effect of CSF drainage on neurological symptoms and deficits. Placement of lumbar catheter may be necessary under fluoroscopic guidance due to technical difficulties in identifying the lumbar interspace using anatomic landmarks that can be inaccurate in one-fourth of the patients [11] or ascertaining catheter manipulation and position in relation to lumbar spinal canal [7]. Wynn et al. [2] reported their experience with lumbar catheter placement in 486 patients undergoing thoracoabdominal aortic aneurysm repair from 1987 to
Based on such data, we implemented a protocol of lumbar catheter insertion using paramedian approach under fluoroscopic guidance for patients referred for procedure to the interventional team.

Methods

We reviewed our experience with placing lumbar catheter using paramedian approach under fluoroscopic guidance for various indications from July 27, 2013 to February 20, 2015. The patients were identified using a retrieval system imbedded within the electronic EPIC medical records. Institutional Review Board approved the methodology for data ascertainment using chart review. An effort was made to document in detail the issues pertaining to technical success and periprocedural complications associated with every procedure since the time of protocol implementation. The data collection was supplemented by the review of procedural and medical records.

In general, the procedure was performed under awake conditions. The patient was placed in prone position and preparation and draping of the patient was performed using standard sterile protocol. The image intensifier was positioned to acquire a view in which the transverse processes projected in the midline between the pedicles. The image intensifier was angled to optimally demonstrate the space between the spinous processes and laminae of L3 and L4, or L4 and L5 vertebrae. The oblique parasagittal technique was performed by placing the needle on left (rarely right) side of the spinous process. The fluoroscopic beam was placed in caudal angulation. The syringe and needle (25 gauge) was used for local subcutaneous lidocaine injection along the projected needle track. A 14-gauge Tuohy spinal needle was advanced into the interspace between the spinous processes and laminae of L3 and L4 or L4 and L5 vertebrae. CSF was withdrawn. Infrequently, 1 cc of contrast omnipaque [Iohexol, GE Healthcare, Fairfield, CT] was injected through the needle if retrograde CSF flow was not observed. Due to the overlying soft tissue mass, sometimes the needle reached the junction between epidural and CSF spaces (junctional position). Such a position allowed return of CSF through the needle, but catheter advancement was not possible. The needle was advanced further by indenting the subcutaneous tissue.

The lumbar catheter (CODMAN lumbar external drainage catheter, 80 cm in length with precoiled hydrophilic guidewire, Codman & Shurtleff, Inc, Raynham, MA) was advanced cephalad through the needle into the subarachnoid space approximately three levels above site of insertion. To promote return of the CSF through the catheter, patient was infrequently asked to perform Valsalva maneuver and/or operative bed was placed in reversed Trendelenburg position. Rarely, a 3-cc syringe was used to aspirate small amount of CSF through the catheter prior to connecting to a drainage bag. The exterior portion of the catheter was contained using a circular configuration and covered entirely by sterile dressing. The transparent adhesive sheet also covered a portion of the connecting catheter between the lumbar catheter and drainage bag. The position of the catheter was adjusted to target 10–20 cc of CSF per hour under gravity. No antibiotics were used prophylactically before or after lumbar catheter placement. During the study duration, one lumbar catheter was placed at bedside without fluoroscopic guidance. The patient developed meningitis 2 days after catheter insertion and no further catheters were placed at bedside.

The analysis was descriptive and rates of various indications, technical success, and clinical events were ascertained and presented as frequencies. For continuous variables, such as age and duration of catheter implantation, the values were presented as mean (with standard deviation).

Results

A total of 43 lumbar catheter placements under fluoroscopic guidance were attempted of which 31 were performed under biplane angiographic unit and 12 were performed using mobile C arm fluoroscopic X-ray equipment. The mean age (±standard deviation) was 62.3 (±19.6) years; 23 were men. The indications for the procedure were evaluation of normal pressure hydroce-
phalus \((n = 30)\), treatment of communicating hydrocephalus secondary to subarachnoid or intraparenchymal hemorrhage \((n = 5)\), evaluation of previously diagnosed idiopathic intracranial hypertension \((n = 3)\), treatment of cerebrospinal fluid leak due to pituitary surgery \((n = 1)\), decompression of spinal cord following surgery \((n = 1)\), and headaches suspected to be due to idiopathic intracranial hypertension \((n = 3)\). An intracranial mass lesion (intraparenchymal hemorrhage) was present in two patients- ((Figures 1 and 2). Among the 43 patients in whom the procedure was attempted, 18, 1, and 1 patients were on aspirin, clopidogrel, and combination of both, respectively. Two of the patients who were on aspirin, were also using dipyridamole. One of the patients was on warfarin that was discontinued prior to procedure and patient was placed on aspirin. Preprocedure value for international normalized ratio was 1.1. The procedure was performed in the same session with a second procedure in four patients; all four underwent a cerebral angiogram after lumbar catheter placement. Of the 43 catheters attempted, the lumbar catheter placement was successful in 42 of 43 attempted placements. In a 66-year-old man, lumbar catheter insertion was attempted for the evaluation of normal pressure hydrocephalus. Patient has previous history of lumbar spinal fusions and the oblique parasagittal technique was unsuccessful in catheter insertion at both L4–L5 and L3–L4 levels. The procedure was subsequently aborted. The 42 successful procedures were performed in prone position in all but one patient in whom a lateral decubitus position was necessary. Patient had multi-level spinal surgery and could not tolerate prone position due to back pain.

One patient, 57-year-old man, had severe CSF depletion (empty thecal sac phenomenon) secondary to CSF leakage following pituitary surgery. A previous attempt to place lumbar catheter the day before without fluoroscopic guidance was unsuccessful. The adequacy of catheter placement was confirmed under fluoroscopy (Figure 3). CSF was not initially withdrawn, but drainage started after 2-h postinsertion. No CSF was retracted in one patient due to junctional position. The junctional position was confirmed by the injection of contrast (Figure 4). The patient was a 76-year-old man (height 167.6 cm and weight 254 pounds) who underwent the procedure for the evaluation of normal pressure hydrocephalus. In one patient, needle was advanced further by indenting the subcutaneous tissue. In another patient, a 65-year-old man height 180.3 cm and weight 255 pounds) junctional position of the needle required reinsertion of the needle at a spinal level above the first insertion to reduce the interposing space between skin and subarachnoid space.

The lumbar catheter remained in position over a mean period (±standard deviation) of 4.1(±2.3) days. One patient developed CSF leakage through the catheter insertion track following removal of catheter and required skin suturing at the site of insertion to treat the leak. No events of meningitis were observed in any of the patients. Improvement in symptoms following catheter placement was seen in three patients with idiopathic intracranial hypertension, four patients with communicating hydrocephalus secondary to subarachnoid or intraparenchymal hemorrhage, one patient with headaches, and one patient with paraparesis. Among the 30 patients with normal pressure hydrocephalus who underwent temporary CSF drainage for diagnostic purposes, permanent cerebrospinal fluid shunts were consequently placed in seven patients based on the findings.

**Discussion**

We report our experience with fluoroscopic guided lumbar drainage catheter placement using paramedian approach. The drain was successfully placed in 42 of the 43 patients in whom the procedure was attempted. We performed all but one procedure in prone position because prone position has unique advantages in visualizing important landmarks such as transverse and spinous processes of vertebrae distinctly because of considerable freedom in aligning the fluoroscopic plane by moving the image intensifier in several directions. The prone position is relatively comfortable for the patient and a stable operative field can be maintained throughout the procedure. We used paramedian approach because previous studies have reported higher technical success rates and lower vascular puncture rates compared with median approach [12–15]. The lower rate of vascular puncture with paramedian approach may be of considerable value in patients using antiplatelet medications. Paramedian approach also does not require flexed position of the spine [12] and therefore the procedure is better tolerated in patients with degenerative spinal disease or obesity.

Using a combination of fluoroscopy in anteroposterior and lateral planes, insertions and advancements of Tuohy spinal needle lateral and superior to the spinal process into the intervertebral space were completed in one pass with minimal need for reinsertion. In three patients, fluoroscopic guidance allowed adequate placement of insertion needle despite initial placement in junctional position or empty thecal sac phenomenon with no CSF return. We found that return of CSF through a Tuohy spinal needle at junctional position can be misleading. Only the distal most part of the distal
ostium of the needle may be in the subarachnoid space and majority of the distal ostium may be in the epidural space. Advancing the catheter through the needle will result in resistance to passage of the catheter as it enters the epidural space. Injection of contrast to opacify the position of the distal end of the needle was helpful in such a scenario. A limitation of performing the procedure in prone position was that initial return of CSF

Figure 1. Lumbar catheter placement in a patient with basal ganglionic intracerebral hemorrhage and communicating hydrocephalus. Transverse (A) and coronal (B) sections demonstrating hydrocephalus prior to placement of lumbar catheter; Transverse (C) and coronal (D) sections 2 days after lumbar catheter placement demonstrating some improvement in hydrocephalus without any radiological evidence of transtentorial herniation.
through the length of the lumbar catheter was not robust
and infrequently required Valsalva maneuver, inclining
the operative bed, and aspiration. In one patient, none of
the above-mentioned maneuvers were successful in ac-

The procedure was successfully completed without any
hemorrhagic complication in 16 patients who were on
antiplatelet agents at the time of catheter insertion. In

Figure 2. Lumbar catheter placement in a patient with lobar intracerebral hemorrhage and communicating hydroce-
phalus. Transverse sections (A and B) demonstrating hydrocephalus prior to placement of lumbar catheter; Trans-
verse sections (C and D) 4 days after lumbar catheter placement demonstrating prominent improvement in hydroce-
phalus without the obliteration of basal cisterns.

appeared to be devoid of CSF (empty thecal sac phe-
nomenon) due to fluid loss during pituitary surgery.
two patients, intracranial mass lesion was present but lumbar catheter placement did not result in any herniation of posterior fossa structures. The rates of clinical complications associated with lumbar catheter placement were low. The only complication was cerebrospinal fluid leakage at insertion site after the removal of catheter which required suturing of overlying skin. Patient remained asymptomatic from the cerebrospinal fluid leakage. Several complications have been described with placement of lumbar drainage catheters including subarachnoid hemorrhage [1,7,16,17], meningitis [18,19], catheter fracture [16], worsening of neurological deficits [2], and herniation of posterior fossa structures [20]. Because of such complications, investigators have questioned the value of the procedure and associated risk benefit ratio [1,6]. We found no event of meningitis, a low rate that may be attributable to the procedure being performed in operating rooms under global sterile precautions. The low risk of subarachnoid or subdural hemorrhages is probably due to minimal number of spinal needle insertions required to access the lumbar spinal canal under fluoroscopic guidance. We did not discontinue antiplatelet agents in patients who were using these agents and found such a practice relatively safe similar to observations of some of the other investigators [2]. No patient developed herniation of posterior fossa structures [20].

Figure 3. Junctional position of the Touhy spinal needle. A, Anteroposterior, and B. Lateral views of the Touhy spinal needle position where cerebrospinal fluid return was observed but lumbar catheter could not be advanced; C, Anteroposterior, and D. Lateral views acquired after contrast injection from Touhy spinal needle. Notice the simultaneous contrast spread along the epidural space and dispersion in the subarachnoid space suggesting a junctional position; E, Anteroposterior, and F. Lateral views of the lumbar catheter being advanced into the subarachnoid space after the spinal needle was advanced by indentation in overlying subcutaneous tissue. Notice the relationship of catheter and epidural space opacified by contrast spread.
fossa structures despite the presence of intracranial lesions in two patients presumably because none of them had compressive manifestations in posterior fossa. Huttner et al. [4] have reported similar findings in patients with intracranial hemorrhage undergoing lumbar catheter placement in whom an intraventricular catheter was already in position.

We demonstrate the feasibility and effectiveness of lumbar catheter placement under fluoroscopic guidance by paramedian approach as a first line strategy in patients requiring such a procedure. The biggest limitation of our report is the relatively small number of patients who underwent the procedure in our series that limits the precision of estimates. The event rates of technical failure [7] are less than 10% with lumbar catheter placement. The 95% confidence interval is 9.94% for an event rate of 10% in a sample size of approximately 40 patients [21]. The heterogeneity of the patient population in regards to indications may have cause an unmeasured bias. Further studies would have to determine whether image-guided lumbar catheter placement should be used in patients in whom standard methodology using anatomical landmarks have failed [7,22] or should be considered first line to reduce technical failures and clinical complications as implemented in our study and study by Wynn et al [2].

**Disclosure**

None.

**References**

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