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Treatment of 213 patients with Symptomatic Tarlov Cysts by CT-guided Percutaneous Injection of Fibrin Sealant

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Abstract

Purpose—The purpose of this study was to analyze the safety and efficacy of intervention in patients with symptomatic Tarlov cysts by percutaneous, CT-guided two-needle cyst aspiration and fibrin sealant injection.

Materials and Methods—This study was designed to assess outcomes in patients who underwent CT-guided aspiration and injection of one or more sacral Tarlov cysts at Johns Hopkins Hospital between the years of 2003 and 2013. In all, 289 cysts were treated in 213 consecutive patients. All of these patients were followed for at least six months; 90% were followed for one year and 83% were followed for three to six years. The aspiration-injection procedure employed two needles and was carried out with local anesthesia and intravenous analgesia. In the fibrin injection stage of the procedure, a commercially available fibrin sealant was injected into the cyst through the deep needle (Tisseel VH; Baxter Healthcare, Westlake Village, California).

Results—One year post-procedure, excellent results had been obtained in 104 patients (54.2% of patients followed) and good or satisfactory results had been obtained in 53 patients (27.6%). Thus, 157 patients (81.8%) in all were initially satisfied with the outcome of treatment. At three to six years post-procedure, 74.0% of patients followed were satisfied with treatment. There were no significant complications.

Conclusions—The aspiration-injection technique described herein constitutes a safe and efficacious treatment option that holds promise for relieving cyst-related symptoms in many patients with very small risk.

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Introduction

Perineurial 'Tarlov' cysts (TC) are extrathecal CSF-filled cavities in the perineurial recesses around dorsal spinal nerve-roots. Composed of vascularized connective tissue lined with flattened arachnoid tissue, TC characteristically contain nerve-root fibres and ganglion cells in their walls or cavities and tend to be sacral in location.[1;2] They are also notable for their restricted connection to the subarachnoid space and thus exhibit delayed filling during spinal myelography.[1] TC characteristically contain nerve-root fibres and ganglion cells in their walls or cavities and tend to be sacral in location.[1;2] They are also notable for their restricted connection to the subarachnoid space and thus exhibit delayed filling during spinal myelography.[1] TC characteristically contain nerve-root fibres and ganglion cells in their walls or cavities and tend to be sacral in location.[1;2] They are also notable for their restricted connection to the subarachnoid space and thus exhibit delayed filling during spinal myelography.[1] he initial characterization of these structures as cadaveric anatomical variants of unknown clinical significance,[3;4] the neurosurgeon I.M. Tarlov recognized TC in patients and established that some cause neurological symptoms that can be cured neurosurgically.[5–10] His 1953 monograph detailed their pathology, including compression and distortion of local nerves and hemorrhage.[10] Ensuing work has established that TC can cause axial sacrococcygeal pain, intrathecal hypotension, perineal pain, sensory loss, and bladder, bowel and sexual dysfunction.[11–13] Radicular symptoms have also been recognized[14], as have electrophysiological correlates[12] and links to collagen dysfunction (e.g., Ehlers-Danlos and Marfan's).[15;16]

Diagnosis preferentially begins with dedicated sacral MRI, which is more sensitive than CT or standard lumbosacral MRI.[17] TC are visualized (but not always reported) on 1–2% of sacral MRIs, with approximately 25% of these believed to cause symptoms.[18] It is often necessary to evaluate subarachnoid connectivity with myelography in order to distinguish TC from intradural ectasias, subarachnoid cysts, and meningeal diverticulae – cystic abnormalities that are frequently confused with TC, and for which intracystic injection is contraindicated to avoid intrathecal spread and arachnoiditis.

Despite misimpressions in many clinical circles that TC are always asymptomatic, there has been steady progress in developing the interventional treatments required for definitive management of symptoms. Conservative approaches including analgesic/anti-inflammatory medication and physical therapy have achieved varying degrees of success in reducing cyst-associated symptoms.[19] Surgical methods, meanwhile, include lumbar-peritoneal and cysto-subarachnoidal drainage and shunting,[20;21] bipolar cautery to shrink cysts,[22] decompressive laminectomy,[23–25] and laminectomy with either total cyst resection,[1;10;26;27] partial cyst wall resection,[28] or duroplasty/plication of cyst walls.[29] Despite standard limitations such as malfunction and infection after shunting, persistence of pain after laminectomy, and radicular deficits after ablative procedures, a prior review found that 88.6% of patients in the studies evaluated were satisfactorily relieved by surgery according to each report's outcome criteria.[14] Microsurgical techniques – such as laminectomies with electrophysiology-guided cyst wall fenestration/imbrication and myofascial flap repair and closure – are also in use, and while these are potentially less effective, they appear to cause fewer adverse effects and better preserve neural tissue.[30–33]

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Minimally-invasive percutaneous techniques have also emerged. In 1994, Paulsen, et al. reported immediate symptom relief lasting up to 3 months after single-needle aspiration of symptomatic TC in five patients.[13] Lee et al. then described using patients' temporary response to cyst aspiration as a diagnostic maneuver to select candidates for surgery.[34]. In 1997, Patel et al. first described injecting autologous fibrin glue into aspirated cysts. 4/4 patients exhibited marked improvement without recurrence during 23 months, with one achieving lasting relief.[35] They postulated that fibrin deposition on cyst walls would impede CSF ingress, trigger fibrosis, and ideally, promote cyst contracture. Zhang et al. subsequently reported that 100% of 31 patients treated with intracystic fibrin glue injection achieved satisfactory relief without recurrence during 28 months of follow-up.[36] This methodology was further refined with Murphy and colleagues' development of the two-needle technique evaluated in this report.[37] Maintaining an equilibrium of intracystic pressure during aspiration-injection, this procedure reduced pressure-related procedural radicular pain sometimes noted with the single-needle technique and perhaps improved fibrin sealant filling.

METHODS

STUDY DESIGN

This study, initiated in 2003 after receiving institutional approval, assessed outcomes in all patients who underwent CT-guided two-needle aspiration-injection of one or more symptomatic sacral TC at Johns Hopkins Hospital between the years of 2003 and 2012. Assessments were repeated at three months post-procedure, one year post-procedure, and yearly thereafter.

PATIENT SELECTION

The study cohort was drawn from patients referred with apparently symptomatic sacral TC. Although six patients were treated for cervical, thoracic, or lumbar TC, these are not discussed here as they were too few to satisfactorily analyze. Referred patients were vetted for inclusion as illustrated in Figure 1. First, a diagnosis of TC was confirmed by imaging all patients with lumbar and sacral MRI in order to identify, characterize, and localize any cystic structures present. All studies were read independently by both an interventional neuroradiologist and a participating neurosurgeon. TC were identified according to Goyal and Wilkis' classification criteria.[2;38] Patients in whom MRI inadequately defined subarachnoid connectivity underwent myelography to assess the rapidity of contrast spread into the cyst and only those without significant connectivity (i.e., those with slowly filling cysts) were considered for inclusion. Depending on the seriousness of their condition and their willingness to enter the study, patients with imaging-confirmed sacral TC were either referred to invasive surgery or considered for aspiration-injection treatment. Those who remained in consideration underwent further examination and testing to determine whether their symptoms could be attributed to visualized cysts (i.e., whether their TC were symptomatic). Confirmation of symptomatic cysts required that axial pain be in the immediate anatomical vicinity of the cyst, that radicular symptoms and signs occur only in the appropriate distribution of cyst-bearing segments, and that other potential pain generators be excluded by imaging or other diagnostic testing. Additionally, 104 patients in

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whom the symptomaticity of cysts was particularly uncertain underwent diagnostic sacral blockade of cyst-bearing roots; this was performed in the standard fashion through the most convenient posterior sensory foramen and utilized fluoroscopic or CT-guidance to place a needle on the cyst bearing root, superior to the cyst and near the next root above. Pain relief commensurate with the agent used plus lack of pain relief with control blocks was required for attribution of symptoms to the blocked cyst.

Exclusion criteria

All patients with cystic abnormalities other than perineurial cysts and patients with cysts possessing considerable (wide necked) direct communication with the subarachnoid space were rejected. Patients who lacked ability to communicate in English, held the probability of inadequate follow-up (e.g., those who lived outside North America), possessed any DSM diagnosis, unexplained symptoms which were not clearly related to cyst bearing roots, or (as assessed by a neurosurgery nurse practitioner) the presence of two or more Waddell's signs (in order to exclude patients whose pain may have considerable non-organic components), and patients with any other probable identified pain generator besides TC were also all rejected for treatment.

PHYSICAL EXAMINATION

All patients were seen by an experienced nurse practitioner who obtained typical neurosurgical history with review of systems and past medical history. All patients were also seen by a neurosurgeon and underwent history, physical evaluation of the spine, and neurological evaluation focusing upon the symptomatic area of the spine. In addition, all patients underwent detailed history and physical evaluation of the territories supplied by cyst bearing nerve-roots. All patients with pelvic, abdominal or genital symptoms were also seen by a gynecologist and/or urologist. Urodynamics were obtained if recommended by the urologist.

Pain and function were evaluated by the Lumbar Spine Outcomes Questionnaire (LSOQ) scale, a validated outcome measure in spinal disease that permits quantification of pain and neurological loss (including bowel, bladder, or sexual dysfunction) and can be administered satisfactorily by telephone.[39] In addition to the severity measures, pain was also described in terms of its spatial and temporal characteristics with aggravating and alleviating factors taken into account.

TREATMENT

All patients had detailed discussion of treatment options including no treatment, pharmacological pain management, invasive surgery, and aspiration-injection. The fact that aspiration-injection was a new and novel technique was emphasized. All patients were given written material explaining these points in accordance with IRB guidelines. Patients who elected for the aspiration-injection procedure were seen by the interventional neuroradiologist and were engaged in a second discussion of the procedure and its risks and benefits.

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METHOD OF ASPIRATION-INJECTION

All patients included in our cohort were treated using the aspiration-injection technique previously described by Murphy et al.[37] Briefly, aspiration was preceded by performance of diagnostic CT (Aquilion 16-slice multidetector CT unit; Toshiba, Nasu, Japan) in order to select the level providing access to the cyst through the thinnest overlying bone. Sedation was induced intravenously. The back was prepared in the usual sterile fashion, with local anesthesia infiltrated into the skin, fat, muscles, and periosteum overlying the sacrum. Two 18-guage needles were advanced into the cyst with CT fluoroscopy (13 frames per second, three adjacent 2 mm 4 mm and 2 mm sections). The tip of the first needle was typically placed deep in the cyst, while the second was placed more superficially. The stylets were removed from both needles and fluid was aspirated via the deeper needle. The more superficial needle served as a venting tube during the aspiration process, allowing air to enter the cyst. Following aspiration, an air-fluid level developed; this was monitored intermittently with CT fluoroscopy for evidence of rapid cyst refilling, which would indicate a connection to the thecal sac. (We avoided using iodinated contrast agents to monitor cyst fluid levels as these fill up the cyst, complicate fibrin injection, and impair fibrin binding while providing no appreciable additional information compared to air-fluid levels). A commercially available fibrin sealant composed of human/bovine fibrin, fibrinolysis inhibitor, thrombin, and calcium chloride was next injected into the cyst through the deep needle (Tisseel VH; Baxter Healthcare, Westlake Village, California). Following our observation that completely filling cysts with sealant often temporarily exacerbated post-procedural radicular pain (likely due to swelling sealant compressing the affected nerve-root or nearby nociceptors), we adjusted the technique such that sealant injection was halted when CT fluoroscopy indicated that the cavity was approximately 75% full rather than 100% full. This was found to address the post-operative pain issue without compromising efficacy. Both needles were then withdrawn and the puncture sites were covered with an antibiotic ointment and a sterile dressing. Patients were observed for two hours after the completion of the procedure before being discharge. They were asked to stay locally for one night and were permitted to return to their normal physical activity immediately, but were advised not to undertake strenuous physical exercise for two to three weeks. If multiple cysts were present, typically only two were treated per session and so some patients returned for repeat sessions.

OUTCOME ASSESSMENTS

Outcomes were evaluated in clinic or by telephone at one day and at six and 12 weeks post-procedure by an experienced nurse practitioner or a neurosurgeon. Lumbar sacral MRI was repeated at 12 weeks and one year post-procedure. Subsequent yearly MRIs were recommended but not required. The primary outcomes – pain and function – were assessed using the LSOQ. An “excellent” outcome required complete pain relief according to the LSOQ scale, discontinuation of all pain medications and treatments, and improvement or stabilization of other cyst-linked neurological signs and symptoms such that no further treatments were required. Patients also had to report satisfaction with the outcome of their procedure and willingness to undergo it again for the same result. A “good/satisfactory” outcome required pain to have “improved quite a bit” on the LSOQ scale plus discontinuation of narcotic analgesics. Neurological deficits had to be commensurate with

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adequate function or no further progression. Patients also had to be satisfied with the results and not seeking further treatment. All outcomes other than “excellent” or “good/satisfactory” were reported as treatment failures even if some improvement was noted.

RESULTS

The 213 patients described in this paper had all been followed for at least six months by the time of submission, with 192 (90.1%) of these patients having been followed for one year and 177 (83.1%) of them having been followed for between three and six years.

CHARACTERIZATION OF CYSTS

Overall, the 213 patients treated had 289 cysts between them. 144 patients had unilateral, cysts and symptoms and 69 patients had bilateral cysts. Multiple cysts ranged from two to nine and the average was three for each patient in whom multiple cysts were treated bilaterally. Nine patients had S4 or S5 cysts, but none were symptomatic in isolation. These imaging findings are summarized in Table 1.

NEUROLOGICAL SYMPTOMS AND SIGNS

Local pain in the region of the cyst that is aggravated by sitting down was the most common complaint in our cohort, though S-1, S-2 sciatica and neuropathy was also prevalent. Patients with isolated S-2 root cysts and no evidence of S-1 nerve-root compression characteristically had sciatica proceeding no further than the medial heel and immediately adjacent sole. Additionally, many patients complained of generalized sacral and/or lumbar pain, pelvic and/or perineal pain, and sexual, bladder, or bowel dysfunctions. Common bladder complaints included incontinence, urinary frequency or urgency, and inability to fully empty the bladder, while bowel dysfunction tended to involve urgency or mild incontinence. The most common physical neurological abnormality observed in our patients was an absent ankle reflex. Weakness of plantar flexion was also prevalent, as were cyst-related sensory loss, reduced rectal sphincter tone, and bladder sphincter impairment. Sensory loss most frequently occurred in the perineal region and usually co-manifested with perineal pain. Two patients with cysts that compressed the L5 nerve-root exhibited weakness of dorsiflexion and complete footdrop. Table 2 summarizes the presenting signs and symptoms in treated patients.

ASPIRATION-INJECTION OUTCOME

At one year post-procedure, “excellent” results had been obtained in 104 patients (54.2%) and “good/satisfactory” results had been obtained in 53 patients (27.6%). Thus, 157 patients (81.8%) in all were initially satisfied with the outcome of treatment. In seven of the patients who were not satisfactorily treated, the aspiration-injection procedure was not technically feasible. In the remainder, the intervention was carried out but failed to effect satisfactory results at one year post-procedure.

During the three to six-year follow-up, “excellent” results were obtained in 106 patients (59.9%). This represented an increase from the equivalent statistic at one year; all those patients who were classified as excellent results at one year maintained this status into the

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latter follow-up period, and an additional two patients in the “good/satisfactory” category at one year now qualified as excellent results. 25 patients (14.1%) now rated their outcome as “good/satisfactory”, a decline from the number that did so at one year. Overall 131 patients (74.0%) were satisfied with treatment at three to six years follow-up. Only two patients have reported recurrence of symptoms after more than six years.

Table 3 presents a breakdown of the aspiration-injection therapy outcomes with respect to individual signs and symptoms.

RE-ASPIRATION

23 patients (10.8% of the treated cohort) underwent re-aspiration within the first six months due to recurrent symptoms after immediate short-term relief. 13 patients (6.1% of the treated cohort) underwent re-aspiration after six months. Two of these had the procedure between six and 12 months after the initial aspiration. In seven, re-aspiration was undertaken after the first year and in three, after two years. One re-aspiration failed but all the others conferred satisfactory relief again. One patient underwent three re-aspirations for recurrent symptoms at two-year intervals. Repeat MRI demonstrated fluid-filled cysts in all patients who underwent re-aspiration, evidencing cyst reaccumulation following the initial procedure.

COMPLICATIONS

There were no documented infections or nerve injuries in the treated cohort. One patient had a mild nonspecific allergic reaction with systemic hives, which led to overnight hospitalization out of caution but resolved without incident. Three patients appeared to experience elevated inflammation; all resolved without treatment over 2–4 weeks however.

Seven patients had symptoms of spinal fluid leak and required a post-procedure blood patch for control. 20 patients had increased sciatica following the procedure that resolved within less than three months. One patient had increased sciatica that persisted for more than three months but eventually resolved. Seven patients complained of severely increased local pain; this resolved in six of these patients within three months. Three patients described an increase in all symptoms including bowel and bladder dysfunction immediately following injection, although all of these were transient and resolved within three months. There was no incidence of aseptic meningitis.

SURGICAL OUTCOME

Patients who had been referred for surgery initially and 11 patients who failed aspiration and were subsequently referred for surgery were followed on the same schedule employed for aspiration patients. Of the initial 34 patients referred for surgery, 31 (91.2%) achieved excellent or satisfactory relief and were satisfied with their surgical outcome. The remaining three patients underwent surgery that proved to be partially successful, but continued to have complaints afterwards. Nonetheless, no worsening of patients’ conditions or significant increases in neurological deficits resulted from surgery in these cases. Of the 11 patients who failed aspiration and were referred to surgery, all had successful relief of symptoms.

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DISCUSSION

Contrary to popular sentiments held in the medical community, current data indicates that at least some TC are symptomatic. Beyond the simple correlational finding that a consistent set of symptoms are associated with certain cysts, perhaps the strongest evidence for this position is the well-documented effectiveness of surgical treatment of apparently symptomatic cysts. Since Tarlov described the successful resection of symptomatic perineurial cysts in 1953,[10] there has been a steady progression of case reports and small surgical series that report successful surgical treatment of such cysts with concomitant relief of patients' symptoms and improvement in their neurological dysfunction.[20–33] Accepting the authors' criteria for success, collation of these studies' outcomes indicates that 88.6% of patients were satisfactorily relieved of symptoms with relatively low morbidity and mortality (no deaths or serious neurological worsening are reported). Similarly, this study found that 91.2% of the 34 patients referred directly for surgical obliteration (as opposed to aspiration-injection treatment) of their cyst(s) achieved excellent or satisfactory outcomes, while the remainder reported at least some improvement and suffered no worsening of symptoms or neurological signs. Relief of symptoms and signs following treatment has long been used in neurosurgery to justify attribution of both to specific pathology; the success of herniated disc excision and decompression of spinal stenosis, for instance, have – supported by excellent clinical research data – helped cement symptomatic attribution to their respective pathologies. As such, this body of evidence strongly supports both the contention that some TC are symptomatic and that these symptoms can be relieved by surgical intervention.

Such a position is also bolstered by the favourable results obtained by several studies[13;34–37] that treated symptomatic TC with variants of the aspiration-injection technique, including the current paper. Moreover, we believe that our data help justify the image-guided aspiration of probable symptomatic cysts and their injection with fibrin sealant as a less-invasive alternative treatment to surgical measures. The initial and long-term success rates for this technique are high enough to hold promise for its adoption as an adequate and efficacious therapy option, with 81.8% of treated patients satisfied with the intervention in terms of its effects of their symptoms at one year post-procedure and 74.0% satisfied at three to six year follow-up. Additionally, our data indicate that aspiration-injection treatment is associated with low morbidity and adverse effects; no instances of neurological injury occurred among those treated in our cohort, and only eight patients suffered from minor complications (all of which resolved without need for further operation). Only four patients reported worsened pain following the procedure, but two of these recovered shortly afterwards and a third was lost to follow-up. Of special note is the utter lack of instances of post procedural aseptic meningitis (reported by Patel et al.[35] to occur in 75% of patients) in our series; we surmise this may be because we treated only narrow neck cysts, thus avoiding fibrin reflux into the thecal sac and subarachnoid space. The fact that all of the 11 patients who failed aspiration treatment were subsequently successfully treated with surgery also indicates that the former procedure does not reduce the chance or extent of success for the latter, thus reinforcing the potential of aspiration-injection to be a useful first option treatment for TC.

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It should be emphasized that the simple discovery of a cyst does not justify attribution of the symptoms to that cyst but that cysts smaller than 10 mm have in our experience been symptomatic. Attribution should be based upon the location of the cyst and the ability of these factors to explain (via likely effects on cyst-bearing or neighbouring nerve-roots) local pain and associated signs and symptoms, as well as temporary relief of symptoms with controlled diagnostic blockade of cyst-bearing nerve-roots and the absence of another plausible generator to explain pain and other signs or symptoms. It is also, of course, important not to overstate the prevalence of symptomatic Tarlov cysts, and especially the prevalence of symptomatic Tarlov cysts that require surgical or percutaneous intervention. In this study, a considerable proportion of patients out of the larger group of referred patients were found to be adequately managed by pharmacological means alone without significant evidence of progression.

It is important to consider why these cysts should be symptomatic in the first place. Certainly, the pathological changes associated with perineurial cysts are rather striking; nerves within the cyst-bearing dorsal nerve-roots – structures notoriously sensitive to compression – may be distorted, compressed, and injured by the bulging cyst, and adjacent nerves are often also compressed.[1;10] Given that afferent nerves populate this area, one may make a direct link between such pathological changes and the (not infrequently) accompanying radicular symptoms, such as neuropathic pain, paresthesias, and sensory loss/ neurophysiological abnormalities. Additionally, cyst pressure is known to be great enough to erode sacral bone and has been hypothesized to sensitize dural and/or periosteal nociceptors in this way.[10;40] It is possible that this second mechanism is primarily responsible for the local, nociceptive pain that often characterizes symptomatic cysts. Meanwhile, the worsening of both radicular and local symptoms over time could be attributed to the gradual enlargement that some cysts may undergo.[1;22]

Finally, it is worthwhile interrogating why the fibrin sealant used in the aspiration-injection procedure should be effective at treating symptomatic TC over the long-term, since it is known that the compound is slowly absorbed in the body such that permanent cyst obliteration would not occur. Our underlying hypothesis (shared by Patel et al.[35]) was that the injection of sealant into the cyst would thicken the wall of the cyst via fibrosis and block the one way valve at the neck of the cyst, reducing the entry of spinal fluid (and thereby preventing the cyst from distending and compressing local nerves or stimulating nearby nociceptors). This hypothesis remains unproven from these data. Still, some support exists for such a position. In the case of reoperation of neurosurgical procedures using fibrin sealant, the formation of a thin impermeable membrane is frequently evident in the operative site.

CONCLUSIONS

Despite widespread belief to the contrary, it has been known for some 70 years that perineurial cysts are sometimes symptomatic and that associated symptoms and signs may be relieved by successful treatment of the troublesome cyst. Surgical methods are effective but are often complicated by infection, post-operative CSF leak, or damage to neural tissue; these make them an imperfect first option treatment and suggest the need for a percutaneous

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image-guided approach. The aspiration-injection technique described herein constitutes a safe and efficacious treatment option, and one that holds promise for relieving cyst-related symptoms in many patients with very small risk.

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ABBREVIATION KEY

CSF	cerebrospinal fluid
TC	Tarlov cyst
CT	computed tomography
MRI	magnetic resonance imaging

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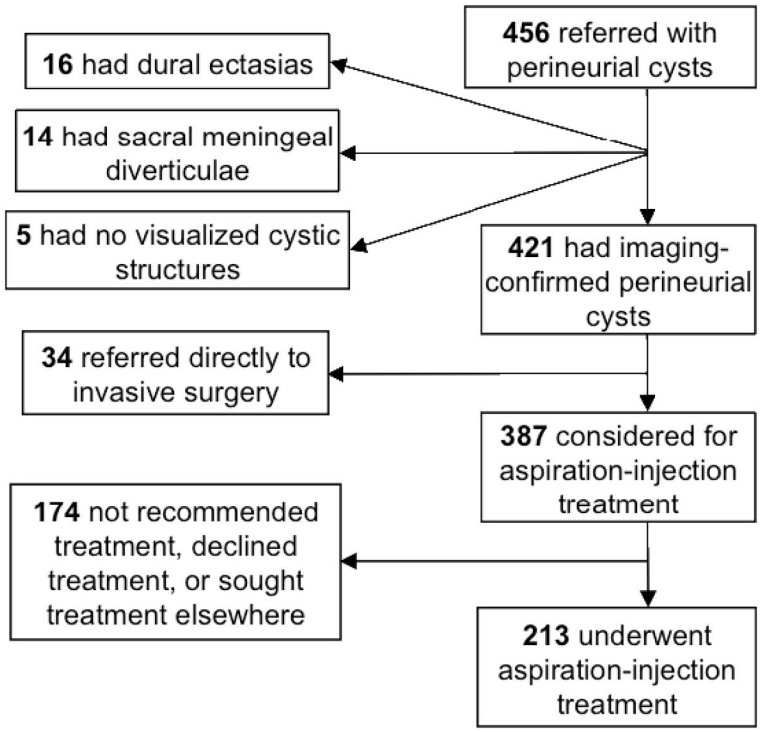

Figure 1.
Patient recruitment flowchart for aspiration-injection therapy.

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Table 1

Imaging Findings

Findings		**Number of Patients**
Position/Number of Root Nerves Involved	Unilateral – Single Root	113
	Bilateral – Single Root	78
	Bilateral – 2 or more Roots	22
Nerve-Root Localization	L4	1
	L5	1
	S1	16
	S2	142
	S3	120
	S4 – S5	9
Aspirated Cyst Size	1 – 2	
	2 – 3	111
	3 – 4	32
	> 4	8

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Table 2

Neurological Symptoms and Signs

Symptom/Sign	Number of Presenting Patients
Local Pain	210
L4, L5 Neuropathy	2
S1, S2 Sciatica	151
S1, S2 Neuropathy	137
Generalized Sacral/Lumbar Pain	189
Pelvic/Perineal Pain	209
Bladder Dysfunction	92
Sexual Dysfunction	92
Bowel Dysfunction	62
Absent Achilles Reflex	130
Weakness of Plantar Flexion	87
Paralysis of Plantar Flexion	2
Paralysis of Dorsiflexion	2
Rectal Sphincter Tone Reduction	61
Bladder Sphincter Impairment	92
Cyst-Related Sensory Loss	
L4	1
L5	1
S1	16
S2	137
S3, S4, S5	97

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Table 3

Outcome of Aspiration-Injection Therapy

Symptom/Sign	Outcome		
	Excellent	**Good**	**Unchanged**
Local Pain	87 (41.4%)	72 (34.3%)	51 (24.3%)
Sciatica/Neuropathy	81 (53.6%)	32 (21.2%)	38 (25.2%)
Perineal Pain/Sensory Loss	86 (41.4%)	70 (33.5%)	53 (25.4%)
Bladder/Sexual Dysfunction	30 (32.6%)	38 (41.3%)	24 (26.1%)
Bowel Dysfunction	22 (35.5%)	23 (37.1%)	17 (27.4%)
Plantar Flexion Weakness	44 (50.6%)	20 (23.0%)	23 (26.4%)
Plantar Flexion Paralysis	0 (0%)	0 (0%)	2 (100%)
Dorsiflexion Paralysis	0 (0%)	0 (0%)	2 (100%)
Rectal Sphincter Reduction	22 (36.1%)	23 (37.7%)	16 (26.2%)