Rate of Conversion to Surgery and Risk Factors Analysis Following Fluoroscopically Guided Facet Cyst Rupture

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Introduction

Juxtaarticular cysts, which are composed of ganglion and synovial cysts, arise from periarticular tissue and can occur in any joint. Cysts that are lined with synovium and communicate with the joint are characterized as true synovial cysts while cysts without a synovial lining that do not communicate with the facet joint are known as ganglion cysts[1]. While ganglion and facet cysts can look alike externally, there are histologic and pathologic differences. Synovial facet cysts are thought to originate from instability of the facet which leads to herniation of the synovial membrane either due to tissue laxity, as seen in younger women, or degenerative joint disease, as seen in older patients[2]. Additional etiologies of facet cysts could be due to myxoid degeneration or increased production of hyaluronic acid. Regardless of the etiology, herniation of the synovial membrane can lead to spinal cord or nerve root compression.

Facet cysts are a common finding on magnetic resonance imaging (MRI) when evaluating a patient with back pain and radicular symptoms. The reported prevalence of these cysts can vary widely, and studies have shown results ranging from 0.5% to 7.3%[3,4]. These facet cysts have a wide range of clinical and radiographic findings. Studies have examined the level, size, rim characteristics, and contents of cysts in order to better understand possible pathogenesis.[5,6] It is thought that these variables may relate to the differences in efficacy of treatment.

There are several treatment options for symptomatic facet cysts. Non-operative management can include intraarticular steroid injections or fluoroscopically guided percutaneous rupture, whereas operative management includes direct decompression and cyst excision with possible fusion.[7] While studies currently report the efficacy of percutaneous treatment of facet

cysts to be between 20 and 39%, further research to identify clinical and radiographic factors associated with failure of percutaneous treatment is needed[8-12].

The aim of this retrospective review is to evaluate the rate of conversion to surgery following percutaneous cyst rupture and to examine clinical, radiographic and procedural variables that might be associated with that conversion. Ultimately, if specific clinical and radiographic risk factors can be elucidated, it may be possible to more effectively and efficiently counsel and treat patients.

Materials and Methods

A retrospective review was completed for all patients who underwent fluoroscopically guided facet cyst rupture from 2010-2016 at an academic medical center. All patients who had undergone fluoroscopically guided facet cyst rupture at the authors' institution were included in the study. The procedures were performed in a fluoroscopy suite with a fixed C-arm unit, with the patient in a prone position. After sterile preparation and local analgesia, the inferior recess of the facet joint was targeted using fluoroscopy in the anteroposterior and ipsilateral oblique positions using a 22-gauge needle. A small amount, approximately 1 cc, of Omnipaque iodinated contrast was injected to demonstrate placement within the facet joint. A mixture of 0.5 cc (20 mg) of Depo-Medrol or 0.5 cc (20 mg) of Kenalog along with 0.5 cc of preservative free 0.25% Bupivacaine was injected into the joint, either before or after cyst rupture depending on operator preference. Additional fluid was injected into the facet joint to pressure the cyst and induce rupture. Fluoroscopy images were obtained to demonstrate location of contrast after attempted cyst rupture.

Several variables were chosen based on either prior literature or theoretical association with failure of percutaneous management (Table 1). The clinical variables examined included sex, age, number of comorbidities, laterality (unilateral or bilateral), type of symptoms (pain, motor deficit, sensory deficit), and whether the pain was predominantly leg, back, or combined. The radiographic variables examined included cyst signal, rim signal, presence of spondylolisthesis, presence of canal stenosis, presence of facet joint fluid, bilateral fluid, facet bone edema, bone erosion, cyst opacification, cyst size and cyst shape. The procedural variables examined included the pain score change from immediately pre and post procedure, cyst contrast filling and successful cyst rupture. Finally, post procedure MRIs that were obtained within the

first year after attempted cyst rupture were evaluated to determine the decrease in cyst size and the relationship with decrease in cyst size and conversion to surgery.

The primary outcome was rate of conversion to surgery. For those that converted to surgery, the rate of decompression and fusion compared to decompression alone was recorded. Secondary outcomes included clinical, radiographic, procedural, and follow up MRI variable analysis to determine if there were risk factors associated with conversion to surgery. Categorical variables were analyzed using Fisher's exact test as an alternative to the Chi-square test and continuous variables were analyzed using a T-test.

Results

Forty-nine patients met the inclusion criteria for the study. Four were excluded because they had no clinical notes or because no MRI was available for review. Clinical, radiographic and procedural variables for 45 patients were recorded and examined (Table 1). The average post procedural follow-up for this cohort of patients was 1.4 years.

Twenty-nine percent (95%CI = 15.7%, 42.2%) (13/45) of patients eventually underwent a surgical procedure to address their facet cyst. The average interval to surgery was 95 days (median = 50 ± 105) after attempted cyst rupture. Of those that had a surgical intervention, 38% (5/13) had a decompression and fusion while 62% had decompression alone.

The variables in table 1 were analyzed to evaluate for an association with future conversion to surgery after percutaneous management of facet cysts. The results for the clinical variables are listed in table 2, the results for the radiographic variables are listed in table 3, the results for the procedural variables are listed in table 4.

Of the variables examined in this cohort, the number of comorbidities did have a significant association with later conversion to surgery. Patients that underwent surgery had an average of 7.23 comorbidities and patients that did not have surgery had an average of 4.50 comorbidities ($p = 0.030$). Failure of cyst rupture did trend towards significance for later conversion to surgery ($p = 0.08$). No other clinical, radiographic or procedural variables were associated with conversion to surgery in this cohort.

Thirteen patients had a post procedure MRI within 1 year of the attempted fluoroscopic cyst rupture. These were completed based on various indications from their treating physicians. Nine out of the 13 patients did have a greater than 50% decrease in size of their cyst (Table 5).

This was not a direct correlation with successful cyst rupture. Of those nine, only one eventually converted to surgery.

Discussion

Despite these reported outcomes in the literature, it is unknown which patients that undergo fluoroscopic facet cyst rupture end up converting to surgery. If clinical, radiographic or procedural variables could be determined as predictors of future surgical intervention, then it would be possible to better counsel patients. Furthermore, if it was known who would convert to surgery, it may be possible to skip unnecessary procedures and more definitively treat patients from initial presentation. Although some studies have evaluated certain variables in isolation, a thorough evaluation has not previously been reported.

The meta-analysis done by Shuang et al.[9] showed 38.6% of the 544 patients that had satisfactory results with percutaneous procedures had to eventually undergo surgery to achieve long-lasting relief of symptoms. More recent studies done by Eshraghi et al. in 2016 and Lutz et al. in 2017 reported surgery rates of 20% (6/30) and 31% (11/35) respectively[11,12]. The current study results of 29% fit well within the rates of surgery that have already been reported. With so many studies demonstrating the success of percutaneous management for lumbar facet cysts, it appears to be viable as an initial method of treatment. Percutaneous management carries less risk than surgical management and would be especially useful in higher risk patients that might not be ideal surgical candidates.

Out of the clinical factors from table 1, only the number of comorbidities was shown to have a significant association with the future need for surgical conversion. None of the other clinical variables had any significant association with need for surgical conversion after percutaneous management of facet cysts. Our results for the association between patient sex and age match up with the study conducted by Allen et al. who also found no significance between a successful outcome and patient age or sex[13]. It would be difficult to use the comorbidity finding

to change treatment decisions. Patients with an increased number of comorbidities are, generally, considered more high risk surgical candidates. While surgery is currently the most effective management method as shown in the prospective study done by Schulz et al[14], it makes sense that non-surgical and lower risk approaches should be attempted prior to a higher risk surgical approach for treatment of facet cysts in higher risk patients. This association could, however, be useful for patient education and counseling for the future need of a surgery in order to treat facet cysts.

None of the radiographic variables tested correlated with conversion to surgery. Prior to the statistical analysis, we were expecting cysts with a T2 hyperintense signal to have a decreased need for surgery. Cambron et al. looked at the T2 signal intensity and found that a T2 hyperintense cyst was less likely to have need for future surgery[10]. While the reason for the difference between T2 hyperintense versus intermediate to low intensity cysts is unclear, Cambron et al. suggested that hyperintense cysts could contain a larger amount of fluid while also having less calcifications which could account for greater rates of success after percutaneous management. When compared to our study, while the patient demographics (62% female) and location of lumbar cysts (60% L4-L5) are similar in both studies, Cambron et al. has a much larger sample size at 110 patients. The difference in sample size and increased power could account for the results seen in Cambron's study.

Of the procedural variables tested, only failure of cyst rupture trended towards significance for later conversion to surgery. This makes intuitive sense; however, the conversion to surgery rate for those who failed was still only 50%. Ultimately, further data is needed to help discern how important this variable is to further conversion to surgery.

Finally, the follow up MRI evaluation did have some interesting findings. A decrease in cyst size was seen in 70% of the patients who had a follow up MRI. Of these patients, only 66% were noted to have had a successful cyst rupture, which shows that there is potential for a decrease in cyst size despite the failure of cyst rupture. Of those that had a decrease in cyst size of at least 50%, only one patient converted to surgery. While this was not statistically significant, it was likely limited due to the small sample size of follow up MRIs.

The main limitation of this study is sample size. Because of the small population studied, we were unable to complete a robust analysis of the various clinical and radiographic outcomes that were obtained. If a thorough clinical and radiologic evaluation of a larger population is completed, it may reveal more insight into which patients eventually convert to surgery. Future areas of a research could include a multicenter study which would be able to recruit more patients. Additionally, this was a retrospective review, which carries the limitation of the data available in the medical record.

Facet cysts have been recognized as a cause of spinal stenosis, but their optimal treatment is unknown. Typically, non-operative interventions are attempted prior to surgery, which often includes fluoroscopically guided facet cyst rupture. However, there is a significant percentage of patients in which this treatment fails to provide durable relief, and eventually, patients undergo a surgical intervention. This study shows that there is a large percentage of patients in whom percutaneous management is successful, which is consistent with previously published reports. At this time, we would recommend continuing to attempt fluoroscopic guided facet cyst rupture in all patients with appropriate post procedural clinical monitoring.

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Table 1. Data Variables Collected

Clinical	Sex Age Number of comorbidities BMI Laterality of symptoms Symptoms Pain Location
Radiographic	Cyst signal Rim signal Spondylolisthesis Canal stenosis Facet joint fluid Bilateral fluid Facet bone edema Bone erosion Cyst Opacification Cyst size Cyst shape
Procedural	Decrease in Pain Score ≥50% Improvement Pain Score Same or Worse Cyst Contrast Filling Successful Rupture

Table 2. Clinical Variable Results

	Surgery	No Surgery	P-Value
Sex			
Males	17.6%	82.4%	0.310
Females	35.7%	64.3%	
Age	62.6 ± 10.7	57.6 ± 12.4	0.187
Number of Comorbidities	7.23 ± 3.54	4.50 ± 3.70	**0.030**
BMI (Body Mass Index)	27.54 ± 3.43	28.34 ± 5.16	0.545
Laterality of Symptoms			1
Bilateral	28.5%	71.5%	
Unilateral	28.9%	71.1%	
Symptom Type			
Motor	25.0%	75.0%	0.472
Sensory	38.4%	61.6%	
Pain Location			
Back & Leg	28.9%	71.1%	1
Leg Only	28.5%	71.5%	

Table 3. Radiographic Variable Results

	Surgery	No Surgery	p-value
Cyst Signal			
Low T1/High T2	30%	70%	
High T1/Low T2	100%	0%	0.320
Low T1/Low T2	100%	0%	
High T1/ High T2	0%	100%	
Rim Signal			
Low T1	22%	78%	0.094
Intermediate/high T1	55.5%	45.5%	
Spondylolisthesis			
Present	29.4%	70.6%	1
Absent	28.5%	71.5%	
Canal Stenosis			
Present	30.4%	69.6%	1
Absent	27.2%	72.8%	
Facet joint fluid			
Present	16.6%	83.4%	0.459
Absent	33.3%	66.7%	
Laterality of fluid			
Unilateral	23.1%	76.9%	0.340
Bilateral	36.8%	63.2%	
Facet Bone Edema			
Present	42.8%	57.2%	0.394
Absent	26.3%	73.7%	
Bone Erosion			
Present	0%	100%	1
Absent	30.2%	69.8%	
Cyst Opacification			
Opaque	30%	70%	1
Non-opaque	20%	80%	
Cyst Size	13.69mm ± 2.98	11.9mm ± 5.43	0.270
Cyst Shape			
Round	20%	80%	0.763
Oval	33.3%	66.7%	
Irregular	25%	75%	

Table 4. Procedural Variable Results

	Surgery	No Surgery	p-value
Mean decrease in pain score	2.5 ± 2.8	1.4 ± 2.6	0.243
≥50% improvement in Pain Scores	38.4%	34.3%	1.0
Same or Worse Pain Score	38.4%	37.5%	1.0
Cyst Contrast Filling	92.3%	87.5%	1.0
Successful Cyst Rupture	53.8%	81.2%	**0.08**

Table 5. Follow Up MRI Results

	Successful Rupture	No Rupture	p-value
≥50% Decrease in Cyst Size	75%	60%	1.0
	Surgery	No Surgery	
Of those with ≥50% Decrease in Cyst Size	87%	13%	0.22