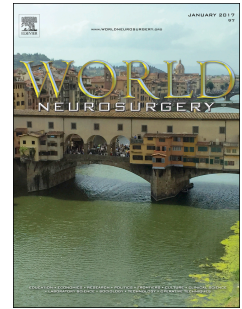


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The Role of Conventional Myelography in the Diagnosis and Treatment of Degenerative Spine Diseases in Low-Income Communities: a Prospective Study

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Key words: myelography, myelopathy, radiculopathy, iohexal, claudication, canal and recess stenosis

ABSTRACT

Introduction

Chronic back pain is a common problem and imaging is crucial for effective diagnosis and treatment. In low-resource settings conventional myelography is a cheap alternative to MRI and CT. This study was conducted to re-examine the diagnostic reliability, effectiveness for surgical decision making and safety of conventional myelography.

Methods

The study was conducted at Tenwek Mission Hospital during June 2009 and March 2010. New patients who presented with features of radiculopathy and/or myelopathy were eligible. Standard anteroposterior views were taken; oblique views were obtained from patients with radiculopathy. Cervical and lumbosacral myelography was performed using iohexal contrast. Patients were observed for complications. Those with surgically remediable lesions underwent operation. Patients were monitored for symptom improvement and complication post-operatively.

Results

Fifty-one (51) patients underwent diagnostic myelography and 39 (77.8%) were positive. Lesions at levels L4/5 23 (59.0%) were the most common. Of patients with cervical lesions, 11 (73.3%) had a positive myelography compared to 28 (77.8%) of patients with lumbosacral lesions. Patients presenting with claudication were more likely to have a positive myelography, compared to those with other symptoms. There were 16 (41.0%) patients with partial spinal canal block, 6 (15.4%) with total block and 17(43.6%) with recess compression. Thirty-eight (38) patients had surgery and recess decompression was the most common procedure (n=24, 63.2%). Following surgery, symptoms due to degenerative disk disease improved in the majority of patients.

Conclusions

Conventional myelography is a reliable and safe diagnostic test. Appropriate and sound surgical decisions can be made following conventional myelography tests.

INTRODUCTION

Chronic degenerative conditions of the spine and their complications are very common in both orthopedic practice and in neurosurgery.¹⁻³ Imaging studies are crucial in the diagnosis and localization of the lesion in order to guide the management.⁴ Magnetic Resonance Imaging (MRI) and Computerized Tomography (CT) Imaging are considered to be the diagnostic tests of choice. Conventional myelography has been largely abandoned and in some centers even discouraged.^{3,5-7} However, in low income countries (LICs) the cost of MRI and CT scanning are beyond the reach of the majority of the patients.⁸⁻¹⁰ Furthermore, in many LICs, centers which can conduct MRI and CT scans are sited in the capital or large cities and are inaccessible to the majority of patients living in rural areas owing to large distances from urban centers.^{8,10} Due to this, the majority of the affected patients in LICs cannot be investigated and will not have surgery. It is common for this group of patients to spend very long periods of times with disabling symptoms, resulting in significant impairment of their ability to work. This leads to a large economic loss that subsequently increases financial strain on families and communities.

In the past conventional myelography proved to be a reliable diagnostic procedure and in some aspects, its accuracy has been found to be superior to that of MRI or CT scanning.^{4-6,11-14} In addition, incidences of complications following iopamidol conventional myelography has been found to be acceptably low.¹⁵ The test has even been carried out safely on outpatient basis.^{4,16-21}

Since plain X-ray facilities are wide-spread and readily available, we sought to re-evaluate the use of conventional myelography in a low-income setting. It is hoped that reintroduction of conventional myelography tests as an acceptable diagnostic tool, would benefit poor communities by widening the availability of spinal surgery and would hugely alleviate preventable suffering of patients with surgically remediable spinal conditions in rural areas. The current study was conducted to re-examine the diagnostic reliability, clinical decision making utility and safety of conventional myelography in a rural setting.

METHODS

Patient Selection

This prospective cohort study recruited 51 patients during the months of June 2009 and March 2010 at Tenwek Mission Hospital. The hospital is located about 225 km northwest of Nairobi, Kenya. At the time of the study there were no MRI or CT services in the hospital but there was a well-functioning plain X-ray machine available.

Patients were included in the study who had been symptomatic for two or more months and who had one or more of the following symptoms: pain (neck, back or referred to an extremity), numbness/loss of sensation, claudication, limb weakness. Patients presenting with new or recurrent symptoms, who were previously enrolled in the study, were excluded. All patients provided consent for study participation, and their management during hospital admission was not impacted by study participation.

Procedures

Myelography was performed by the two principal investigators, a radiographer and a nurse. The level and type of lesion (stenosis, block, and recess compression) were recorded. For the cervical region, patients were positioned prone on the X-ray table with the chin supported to keep the neck extended and the head slightly elevated to prevent contrast from flowing through foramen magnum into the intracranial space. The space between C1 and C2 was identified at 2 cm below and posterior to the mastoid process. 2% lidocaine was infiltrated in the skin and superficial space. A 22-gauge spinal needle was carefully introduced horizontally into the C1/C2 intervertebral space until cerebrospinal fluid (CSF) was recovered. Iohexal 200 (4 mLs) was injected through the needle into the thecal space and the needle was then removed.

For the lumbosacral region, patients were positioned prone with a small pillow under the abdomen to allow caudal and limit rostral contrast flow. The most accessible intervertebral space between L2 to S1 was identified and prepared as for the cervical test. A 20 or 18-gauge spinal needle was carefully introduced until CSF was recovered. Iohexal 300 (5 mLs) was injected into the thecal space and the stylet replaced. The needle was left in situ until the study was completed

to allow for introduction of additional contrast whenever it was necessary or for administration of extrathecal steroid if the study proved to be negative.

Anteroposterior cervical or lumbar X-rays were obtained to demonstrate the findings. Additional oblique views were taken when no spinal stenosis or block was found and where there were clinical features creating a strong suspicion of radiculopathy.

Surgery

When indicated based on myelographic findings, surgical operations were executed. Spinal anesthesia (SA) was used in all cases of lumbosacral operations and general anesthesia (GA) for the cervical region. The myelographic findings were correlated with the operative findings. Analgesics and prophylactic antibiotics were used. While on the ward, Patients were examined daily for evidence of improvement in their symptoms and signs, as well as presence of post-operative wound infection. Duration of stay on ward was also recorded.

Patient Follow-Up

Post myelography, patients were observed for the following complications: headache, confusion, increasing pain, seizures, hypo or hypertension and allergic reactions. All patients who were not booked for surgery on the same or the following day were discharged on the same day. Patients who had surgery were followed up for complications until the time of discharge.

Data Analysis

Data was stored in a password protected database. Stata 12.1 was used for analyses (Stata Corp, College Station, TX, USA). Statistical significance was defined as $P < 0.05$. Comparisons between groups were performed using Fisher's exact test for categorical variables.

RESULTS

Background Demographics

Fifty-one (51) patients underwent myelography based on presenting signs/symptoms. There were 25 males and 26 females. The median age was 50 years. Majority of patients were between ages 26-55 ($n=23$, 41%). Meanwhile, 16 patients were above 55 years of age (31%). Of all patients

who underwent myelography, 39 (75.9%) had symptoms for more than one year, of whom 26 (67.2%) had symptoms for more than two years.

Symptoms and Association with Myelography Findings

Myelography yielded positive findings for 39 (77.8%) of all recruited patients. There were 16 (41.0%) patients with partial spinal canal block, 6 (15.4%) with total block and 17(43.6%) with recess compression. Neck or back pain was the most common presenting symptom followed by extremity pain, with 50 (36.76%) and 38 (27.94%) patients reporting them at presentation, respectively (Table 1). Patients with almost all presenting symptoms, except for neck or back pain, were likely to have a positive myelogram in greater than 80% of cases. There was no association between various presenting symptoms and positive myelography ($p=0.179$) (Table 1). Lumbosacral lesions were more common than cervical lesions, with 36 (70.59%) patients reporting the former and 15 (29.41%) reporting the latter. The most commonly involved spinal levels were L_{4/5}. There was no association between location of lesion and positive myelographic findings (0.773) (Table 1). Figure 1 and 2 demonstrate examples of positive myelography findings seen in our patient population. Figure 1 shows a patient with canal stenosis and recess compression at levels L4/5 and L5/S1. Figure 2 displays severe canal stenosis.

Surgical Management and Findings

Procedures performed for recess decompression included microdiscectomy, hemilaminectomy and foraminotomy for radiculopathy, three of these were of the cervical region. It also included one female patient who had a negative myelography test. Two patients did not turn up for surgery. Breakdown of all surgical procedures that were carried out for patients recruited into the study can be found in Figure 3. The main pathological finding during surgery were bone degeneration ($n=16$, 53%) and disc prolapse ($n=8$, 27%), while 6 patients (20%) had both findings (Figure 4).

Outcomes

Median stay on the ward was 2 days. All patients who had recess decompression alone were discharged within 24 to 48 hours. Following myelography test, only one patient had a mild headache and another one had increased leg pain. There were no seizures, hypertensive or

hypotensive or allergic reactions. Following surgery, 75.8% patients who presented with extremity pain noted clinical improvement, 56.3% patients with extremity weakness noted improvement and all patients presenting with numbness noted clinical improvement (Table 2). Given the patients underwent operations on their necks and backs, pain in that region was not assessed for clinical improvement in the immediate post-operative period. Improvement in claudication symptoms was also not noted as this symptom requires a longer period of time to improve post-operatively. One patient with Potts disease developed a wound infection post-operatively and one patients who underwent anterior cervical discectomy and fusion (ACDF) died.

DISCUSSION

Conventional myelography has long been considered a reliable tool for the diagnosis of central spinal canal stenosis. In cases of severe canal stenosis and disc herniation, various investigators have previously compared its diagnostic capability to that of 3D Magnetic Resonance (MR) myelography and 0.6 Tesla Magnetic Resonance Imaging (MRI).^{13,22,23} Studies have shown that myelography and CT myelography are better able to reproduce results than MRI, and are thus more reliable determining at which level decompressive lumbar surgery should be performed.¹⁴ Further studies reported that conventional myelography is most specific for the diagnosis of canal stenosis than CT myelography or MRI.^{24,25} Compared to conventional myelography, MRI has been shown to provide inconclusive findings in patients with lumbar spinal canal stenosis.²⁶ Furthermore, MRI has been found to underestimate lumbar root compression in up to 30% of patients.¹² Despite these finding from high income countries, there remains a paucity of literature on using myelography in a low-income setting. Our study sought to determine the utility of using conventional myelography to identify surgical amenable lesions in patients presenting with degenerative spine disease.

The demographics of patients recruited to this study match previously published findings.²⁷ The majority of patients in our studies were under 55 years old. The average duration of symptoms was more than 1.5 years and over 52% had symptoms for more than two years. Results confirm that those affected are in their economically productive years. This study also demonstrated that

patients experience long periods of incapacity without proper treatment, and by implication result in bleak socioeconomic consequences due to time lost from inability to perform physical work.

We depended on their clinical presentation to identify suitable candidates to undergo myelography. Our study found that 77.8% of patients presenting with signs and symptoms of degenerative spine disease had positive findings on myelography, which is line with previously published statistics from the US and Pakistan.^{4,11} In our patient cohort, patients presenting with claudication had a positive myelogram in 90% of cases, the highest likelihood of all other presenting symptoms. In high income settings, researchers have used a treadmill test to determine severity of spinal stenosis and need for a myelogram.⁵ Due to the limitation of our study setting, this exam was not feasible. Nevertheless, 23.5% of patients included in our study based on clinical signs and symptoms those who had the inclusion criteria in our study had a negative test. This small number of negative myelograms is consistent with findings of other authors who have noted clinical signs may not always be reliable for a specific diagnosis.^{4,28} Even the benefits of combining different neurological tests during clinical examination to accurately diagnose the level of nerve compression has been challenged.^{19,27} Thus, an imaging study like myelography is always necessary to diagnose the presence of an operable lesion and its level before surgery can be planned.

When comparing the breakdown of myelographic findings, we found that central canal lesions were the predominant pathology, followed by recess compression. Bakhsh et al. reported similar findings in Pakistan, where 66.9% of patients had central canal lesions were and 33.8% had lateral recess findings.¹¹ We found that the major cause for patient presentation was diagnosis of bone degeneration, rather than disc prolapse, which is likely explained by the average patient age in this study. The finding is consistent with the age for the majority of the patients in this study whose mean was 50 years. The preponderance of the lesions at L4/5 and L5/S1 in this study is an established and known phenomenon.^{4,11}

Decision on the type of operation for each patient was based on the findings of the myelography test. Consequently, lateral recess decompression in its different forms; namely hemilaminectomy

and foraminotomy with or without discectomy was the commonest procedure performed. The results in this study show that most patient experienced symptom improvement after surgery. Patients with extremity pain had the lowest percentage improvement, with slightly above 50% noting improvement. This may be due to short follow up period of this study as patients had not had adequate physiotherapy by the time of discharge. The favorable results of outcome following surgery show that the right procedures to match the pathology were chosen before the operation. It is also evidence for the accuracy of the myelography test on which the decision depended.

Following myelography tests, only two patients had very mild complications. Both patients improved on the usual analgesics. Elsewhere, serious post-myelography complications have occasionally been reported.^{4,20,29} Fortunately, we did not see any of these complications in our study. The low incidence and the very mild post-myelography complications have been attributed to the use of the new contrasts like the one used in our study. In our study, patients were taken from the outpatient clinic and those who were not booked for surgery on the same or following day were discharged after the test, in line with the protocol in many other locations.^{4,11,17,21} Outpatient based myelography test approach has shown to be the most cost effective, and therefore suits the situation in poor communities. Termahiro Matsumoto et al reported no statistically different results in a prospective study comparing complications after myelography between out and inpatients. The study also revealed that the outpatient group had reduced costs and freed hospital beds to other patients.

It has been stated that although MRI is superior in many aspects, it could not answer all questions related to the spinal pathology. However, myelography and the subsequent surgical treatment of degenerative spine disease is the suitable approach to address the most prevalent of diseases process that has a huge socioeconomic implication for rural sub-Saharan Africans.³⁰ Myelography is still established as a safe method for some special clinical issues and can provide valuable diagnostic information beyond MRI.^{6,20}

There are several limitations to this study. Mainly, our study contained only 51 patients. This small sample size, and resultant low statistical power which could have resulted in results unrepresentative of the local population. Additionally, we only followed up patients until

hospital discharge. The short follow up period could have led to an underestimation of post-myelography and post-operative complications.

CONCLUSIONS

Conventional myelography tests can lead to a sound clinical judgment for chronic spinal degenerative disorders. Conventional myelography is a safe procedure that can even be administered on outpatient basis. The results of conventional myelography are dependable for the purpose of proper/ appropriate surgical decision making. Conventional myelography procedure skills and interpretation of results should be taught to all residents of clinical neurology and radiologists. The use of conventional myelography tests should be considered especially by practitioners in low income countries.

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Table 1. Myelography results, stratified by presenting symptoms and location (n=51).

	Total, n (%)	Positive, n (%)	Negative, n (%)	Chi2 and Fisher Statistic, P-value
Symptoms*				
Claudication	10 (7.35%)	9 (90%)	1 (10%)	0.179
Neck/Back Pain	50 (36.76%)	35 (70%)	15 (30%)	
Extremity Pain	38 (27.94%)	33 (86.84%)	5 (13.16%)	
Numbness	19 (13.97%)	17 (89.47%)	2 (10.53%)	
Extremity Weakness	19 (13.97%)	16 (84.21%)	3 (15.79%)	
Location[#]				
Cervical	15 (29.41%)	11 (73.3%)	4 (26.7%)	0.733
Lumbosacral	36 (70.59%)	28 (77.8%)	8 (22.2%)	

* In cases when patients presented with multiple symptoms, all symptoms were included in total calculation.

[#] No thoracic levels lesions were detected.

Table 2. Improvement in clinical signs/symptoms after surgery.

Symptoms	Total, n (%)	Clinical Improvement, n (%)	No Clinical Improvement, n (%)	Chi2 and Fisher Statistic, P-value
Extremity Pain	33	25 (75.8%)	8 (24.24%)	0.011
Extremity Weakness	16	9 (56.25%)	7 (43.75%)	
Numbness	17	17 (100%)	0 (0%)	

Figure 1. Myelography results demonstrating canal stenosis and recess compression at L4/L5 and L5/S1.

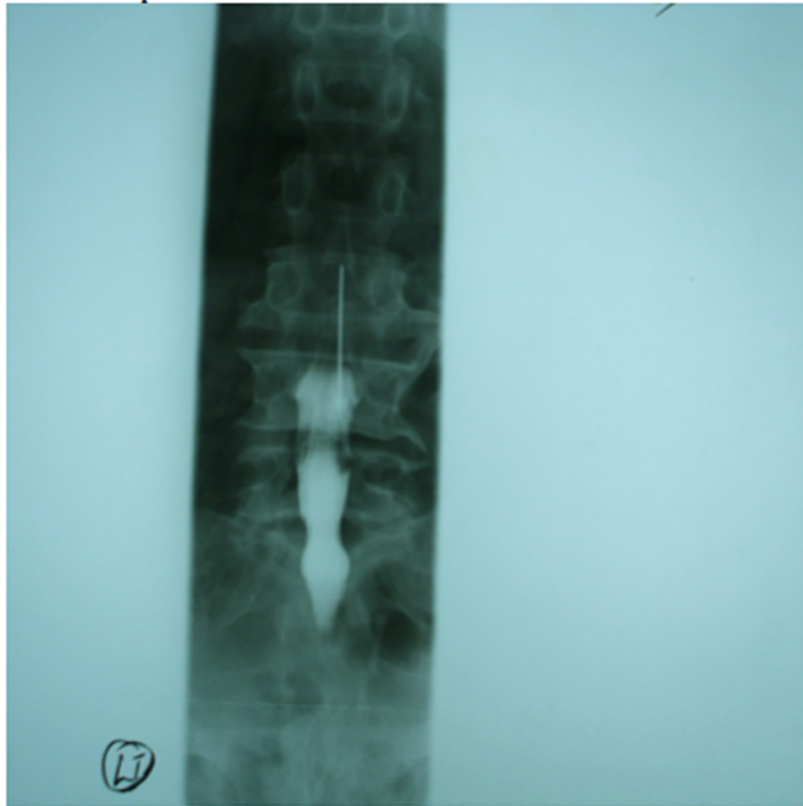


Figure 2. Myelography showing severe canal stenosis in an elderly patient.



Figure 3. Breakdown of Surgical Procedures Performed on Patients Presenting to Tenwek Mission Hospital with Degenerative Spinal Diseases.

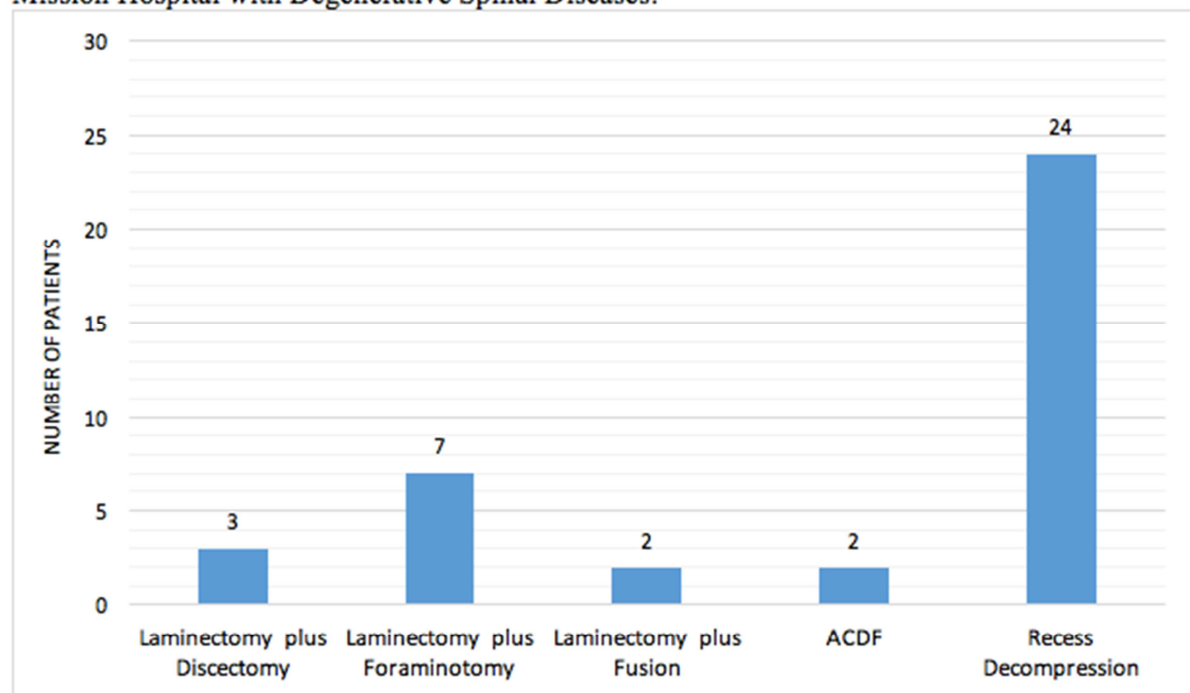
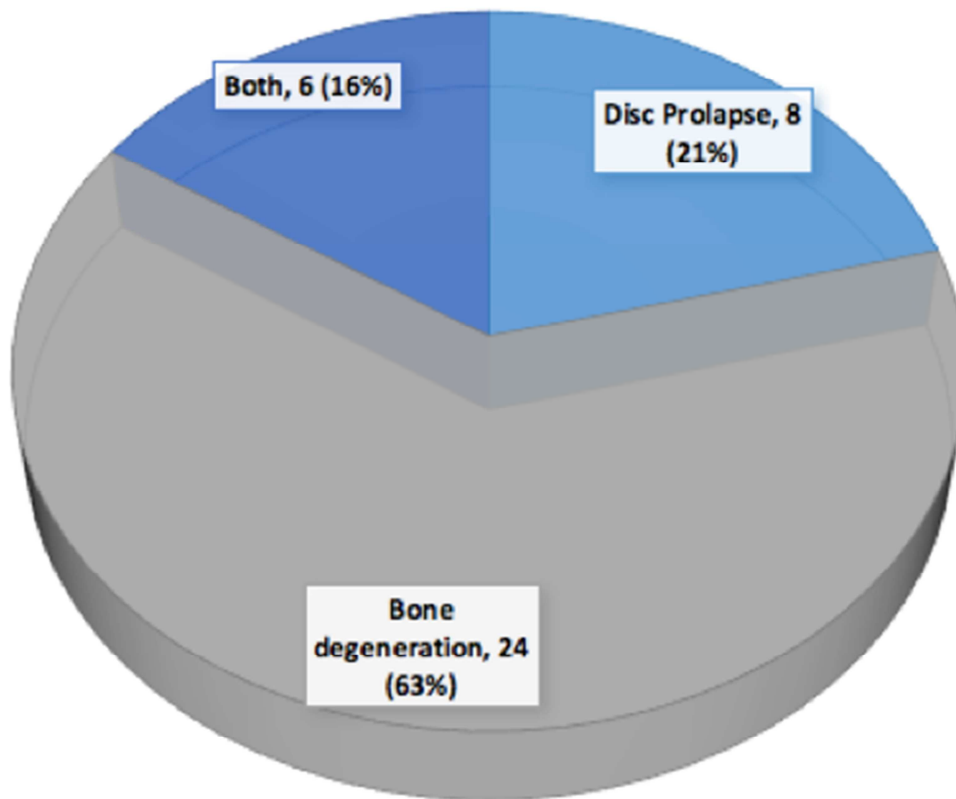


Figure 4. Surgical Findings in Operated Patients Presenting to Tenwek Mission Hospital with Degenerative Spinal Diseases.



- Conventional myelography dependable for appropriate surgical decision making.
- Myelography procedure should be taught to neurology and radiology residents.
- Myelography should be considered by practitioners in low income countries.

Abbreviations:

CT:	Computerized Tomography
MRI:	Magnetic Resonance Imaging
CSF:	Cerebral Spinal Fluid
ACDF:	Anterior Cervical Decompression and Fusion