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Article in *World Neurosurgery* · April 2017

DOI: 10.1016/j.wneu.2017.04.121

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Role of Conventional Myelography in Diagnosis and Treatment of Degenerative Spine Disease in Low-Income Communities: Prospective Study

David Kitya^{1,3}, Maria Punchak^{1,2}, Francis Bajunirwe^{1,3}

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 magnetic resonance imaging and computed tomography. This study was conducted to reexamine 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 iohexol contrast. Patients were observed for complications. Those with surgically remediable lesions underwent operation. Patients were monitored for symptom improvement and complication postoperatively.

RESULTS: Fifty-one patients underwent diagnostic myelography and 39 of them (77.8%) were positive. Lesions at levels L4/5 were the most common, occurring in 23 patients (59%). Of those with cervical lesions, 11 of them (73.3%) had a positive myelography compared with 28 patients (77.8%) with lumbosacral lesions. Patients presenting with claudication were more likely to have a positive myelography, compared with those with other symptoms. There were 16 patients (41%) with partial spinal canal block, 6 patients (15.4%) with total block, and 17 patients (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 spine 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 common in both orthopedic practice and 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 computed tomography (CT) scanning 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 that can conduct these tests are sited in the capital or large cities and therefore inaccessible to most patients living in rural areas owing to large distances.^{8,10} Due to this, the majority of affected patients in LICs cannot be investigated and will not have surgery. It is common for this group of patients to spend 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.

Key words

- Canal and recess stenosis
- Claudication
- Iohexol
- Myelography
- Myelopathy
- Radiculopathy

Abbreviations and Acronyms

- CT:** Computed tomography
- LIC:** Low-income country
- MRI:** Magnetic resonance imaging

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Citation: World Neurosurg. (2017) 104:161-166.
<http://dx.doi.org/10.1016/j.wneu.2017.04.121>

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

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In the past, conventional myelography proved to be a reliable diagnostic procedure. 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 have been found to be acceptably low.¹⁵ The test has even been carried out safely on an outpatient basis.^{4,16-21}

Because plain x-ray facilities are widespread and readily available, we sought to reevaluate 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 hugely alleviate preventable suffering of patients with surgically remediable spinal conditions in rural areas. The current study was conducted to reexamine 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 who were included in the study had been symptomatic for ≥ 2 months and who had ≥ 1 of the following symptoms: pain (neck, back, or referred to an extremity); numbness/loss of sensation; claudication; and 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 2 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 the foramen magnum into the intracranial space. The space between C1 and C2 was identified at 2 cm below and posterior to the mastoid process. Next, 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 was recovered. Iohexol 200 (4 mL) 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 and S1 was identified and prepared as for the cervical test. A 20- or 18-gauge spinal needle was carefully introduced until cerebrospinal fluid was recovered. Iohexol 300 (5 mL) was injected into the thecal space, and the stylet was 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 radiographs 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 on the basis of myelographic findings, surgical operations were executed. Spinal anesthesia was used in all cases of lumbosacral operations, and general anesthesia was used 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 postoperative 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, hypotension, or hypertension and allergic reactions. All patients who were not booked for surgery on the same or 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 were stored in a password-protected database. Stata 12.1 was used for analyses (StataCorp, LLC, College Station, Texas, USA). Statistical significance was defined as $P < 0.05$. Comparisons between groups were performed using the Fisher exact test for categorical variables.

RESULTS

Background Demographics

Fifty-one patients (25 male and 26 female) underwent myelography on the basis of presenting signs/symptoms. The median age was 50 years. The majority of patients were between ages 26 and 55 ($n = 23$, 41%). Meanwhile, 16 patients were >55 years old (31%). Of all patients who underwent myelography, 39 of them (75.9%) had symptoms for >1 year, 20 of whom (67.2%) had symptoms for >2 years.

Symptoms and Association with Myelography Findings

Myelography yielded positive findings for 39 of all recruited patients (77.8%). Sixteen patients (41%) had partial spinal canal block, 6 of them (15.4%) had total block, and 17 of them (43.6%) had recess compression. Neck or back pain was the most common presenting symptom followed by extremity pain, with 50 patients (36.76%) and 38 patients (27.94%) 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 $>80\%$ of cases. There was no association between various presenting symptoms and positive myelography ($P = 0.179$) (see Table 1). Lumbosacral lesions were more common than cervical lesions, with 36 patients (70.59%) reporting the former and 15 of them (29.41%) reporting the

Table 1. Myelography Results, Stratified by Presenting Symptoms and Location ($n = 51$)

				Chi ² and Fisher Statistic. P Value
	Total, Number (%)	Positive, Number (%)	Negative, Number (%)	
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%)	

*When patients presented with multiple symptoms, all symptoms were included in the total calculation.

†No thoracic levels lesions were detected.

*When patients presented with multiple symptoms, all symptoms were included in the total calculation.

†No thoracic levels lesions were detected.

latter. The most commonly involved spinal levels were L4/5. There was no association between location of lesion and positive myelographic findings (0.773) (see Table 1). Figures 1 and 2 demonstrate examples of positive myelography findings seen in our patient population. Figure 1 shows a patient with canal

**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.

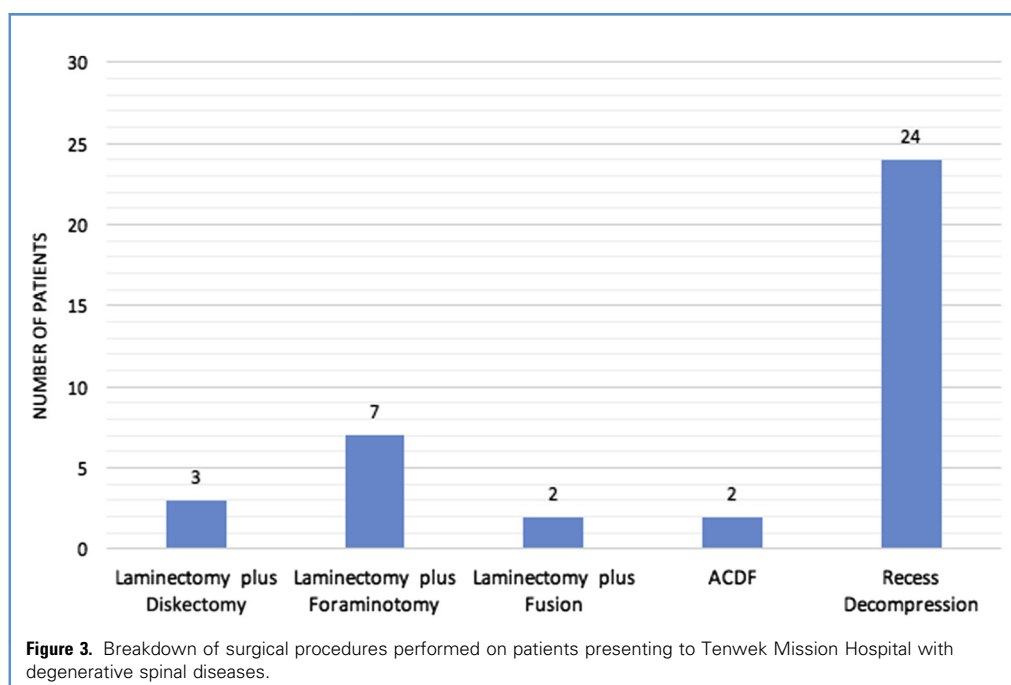
stenosis and recess compression at levels L4/5 and L5/S1. Figure 2 displays severe canal stenosis.

Surgical Management and Findings

Procedures performed for recess decompression included micro-discectomy, hemilaminectomy, and foraminotomy for radiculopathy. Three of these were of the cervical region. Also included was 1 female patient who had a negative myelography test. Two patients did not turn up for surgery. Figure 3 shows a breakdown of all surgical procedures that were carried out for patients recruited into the study. The main pathologic findings during surgery were bone degeneration ($n = 16$, 53%) and disk 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 1 patient had a mild headache and another one had increased leg pain. There were no seizures, hypertension, hypotension, 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 postoperative period. Improvement in claudication symptoms was also not noted as this symptom requires a longer



period of time to improve postoperatively. One patient with Potts disease developed a wound infection postoperatively, and 1 patient who underwent anterior cervical discectomy and fusion 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 disk herniation, various investigators have previously compared its diagnostic capability to that of 3D magnetic resonance myelography and 0.6 Tesla 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 with 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 findings 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.

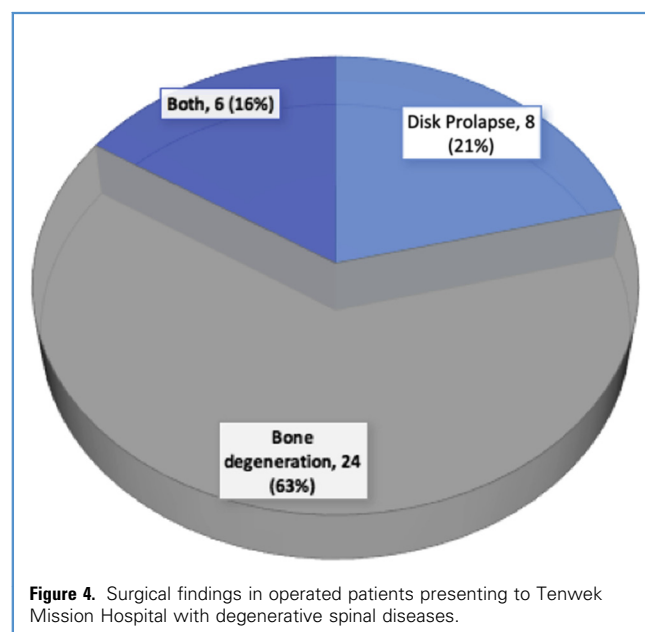


Table 2. Improvement in Clinical Signs/Symptoms After Surgery

Symptoms	Total, Number (%)	Clinical Improvement, Number (%)	No Clinical Improvement, Number (%)	Chi ² 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%)	

The demographics of patients recruited to this study match previously published findings.²⁷ The majority of patients in our studies were younger than 55 years old. The average duration of symptoms was >1.5 years, and >52% had symptoms for >2 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 in line with previously published statistics from the United States 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 examination was not feasible. Nevertheless, 23.5% of patients included 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 neurologic tests during clinical examination to accurately diagnose the level of nerve compression have 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 al¹¹ reported similar findings in Pakistan, where 66.9% of patients had central canal lesions and 33.8% had lateral recess findings. We found that the major cause for patient presentation was diagnosis of bone degeneration, rather than disk 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}

The decision on which type of operation was appropriate 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 patients experienced symptom improvement after surgery. Patients with extremity weakness had the lowest percentage improvement, with slightly above 50% noting improvement. This may be due to the short follow-up period of this study, as patients did not have 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 2 patients had mild complications. Both patients improved on the usual analgesics. Elsewhere, serious postmyelography 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 mild postmyelography complications have been attributed to the use of 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} The outpatient-based myelography test approach is the most cost effective and therefore suits the situation in poor communities. Matsumoto et al¹⁷ reported no statistically different results in a prospective study comparing complications after myelography between outpatients 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 cannot answer all questions related to the spinal pathology. However, myelography and the subsequent surgical treatment of degenerative spine disease are suitable approaches to address the most prevalent disease process, which 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}

This study had several limitations. Mainly, it contained only 51 patients. This small sample size, as well as the resultant low statistical power, 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 postmyelography and postoperative 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 an 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 LICs.

ACKNOWLEDGMENTS

We would like to sincerely acknowledge the contribution of Dr. Bert E. Park for his participation, supervision of this work, and role as a mentor of neurosurgery residents in East Africa. We

appreciate the role of Dr. Russ E. White, who was the medical superintendent of Tenwek Hospital at that time. We extend special gratitude to all staff members at Tenwek Hospital during the

study, George S. Ochwo who helped in data analysis, and Derek Harborne and Josephine Najjuma, who helped in the manuscript writing.

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Conflict of interest statement: None of the authors have any conflicts of interest related to the topic of this study.

Received 15 March 2017; accepted 18 April 2017

Citation: World Neurosurg. (2017) 104:161-166.

http://dx.doi.org/10.1016/j.wneu.2017.04.121

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