

Epidemiology of spinal cord injury from tin mining accidents on the Jos Plateau, North central Nigeria: A Retrospective study

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Abstract:

Background: Globally, road traffic accident is the most common cause of traumatic spinal cord injury. On the Jos Plateau, mining is emerging as an important cause of traumatic spinal cord injury. The disability and complications that follow traumatic spinal cord injury are distressing to the patients and to the medical community as a whole. Spinal cord injury from mining adds more burden to our already overstretched health care system that is struggling to provide basic and specialized health care to the populace. The management of spinal cord injury requires highly specialized care and with the dearth of Specialist to manage this condition, the outcome may become adversely affected. The aim of the study was to study the characteristics of the patients sustaining this type of injury and then measure the outcome of management at our facility.

Materials and Method: Data was obtained retrospectively from the folders of consecutive patients who sustained spinal cord injury from mining accidents and presented to our facility during this period: the data was entered into a proforma and then entered into SPSS version 26 and descriptive statistics obtained.

Results: There were 22 patients, but only 19 patients had complete data and these were the ones used for analysis. All the patients were males except one; age range of 20-50yrs with the mean age of 30.79 ±7.32 years. They were all of low socio-economic status. The most common mechanism of the injury was the collapse of the wall of the pit on the patient (68.4%). Most of them (78.9%) sustained the severe (complete) form of the injury. Only one out of thirteen patients that required surgery was able to afford investigations and surgery.

Conclusion: Mining, especially the type practiced by peasants is highly hazardous and the spinal injury sustained is severe associated with a poor chance of recovery. Proper legislation and enforcement of safety measures at mining sites by government and private companies with the capacity is necessary to reduce the dangers associated with this trade.

Keywords: Spinal cord injury, Tin mining, Jos Plateau, trauma

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I. Introduction

Spinal cord injury from trauma is still a major cause of morbidity and mortality amongst patients presenting to health care facilities in developing nations including Nigeria. To the patient, it is devastating and life threatening; the cost of management extremely high and mostly unaffordable. To the managing Doctor, the management is daunting and often frustrating in the presence of weak health infrastructure. Even where the best facilities are available, the neurologic outcome of those who sustain the severe form of the injury is dismal. The relatives of the patient are left with the great task of caring for these patients which may be lifelong and distressing. In many climes, mining is a highly regulated industry with clear legislations as to the categories of persons licensed to partake and with adequate provision of protective equipment.

Commercial tin mining on the Jos Plateau began in 1904 after a survey revealed large deposits of tin ore on the Jos Plateau.^{1,2,3,4}. The mining was carried out by companies with the necessary heavy equipment and expertise up until the late 1980's and then abandoned. Subsequently, the locals who are peasants took up the trade as a means of survival in the midst of harsh economic realities. They carried out (and still do) the mining activities using very crude methods: using diggers, shovels, which expose them to great dangers including physical injuries². Mining has been described as one of the most hazardous and perilous occupations in the world considering the numbers of persons and the risks involved.^{5,6,7} The international labour organization⁷ stated that in some countries, many are employed in small scale, often informal mining than the formal mining sector. Many of these jobs are precarious and are far from conforming to international and national labour standards. Accident rates in small scale mines are routinely six or seven times higher than in larger operations even in industrialized countries. In the aetiology of spinal injury in the West African sub-region, mining is not

documented as a common cause.^{8,9,10,11,12} The local mining process involves identifying new proper sites or using old sites that were abandoned by the previous major companies, digging vertically to depths of sometimes up to six metres. The diameter is highly variable. Once they reach an appropriate depth, the digging is then extended horizontally creating subterranean trenches called 'lotto' in the local parlance. Some persons stay at the surface to lower down buckets attached to a rope to the person digging down. The person in the pit fetches the dug soil into the bucket and the person(s) at the surface pull this to the surface. Sometimes the rope is attached to a pulley system to ease the work of pulling. The dug material is then washed to separate the ore from the rest of the soil. Figure 1 shows a schematic representation of the mining process and the various mechanisms by which the injuries occur. Some studies have described the socioeconomic impact of tin mining¹³, others discussed the health-related impact of mining^{14,15,16,17,18,19,20} such as lung diseases, exposure to radioactivity and physical injuries, but to the best of our knowledge no study has described in some details the spinal cord injuries sustained during mining. Igun et al²¹ in their study of spinal injuries on the Jos Plateau mentioned tin mining as an important cause of spinal injuries in this area. However, his study was restricted to a much fewer number of patients and there was no detailed characterization of the nature of injuries sustained. In our institution, we have recently noticed an increase in the absolute number of patients presenting with spinal cord injuries occurring at mining sites. This observation has caused us to ask if there is an actual increase in the number of persons who are engaging in this mining activity and thus translating to an increased number coming down with this condition or that they are taking more risks and using less protection. What factors push these persons to engage themselves in this despite the grave dangers associated with this occupation? Though the purpose of our study is not to answer all these questions, our objectives are to document the pattern of spinal cord injuries sustained by these individuals at the mining site, identify the mechanisms by which these injuries occur, identify the factors that increase the risk of injuries and provide possible ways of preventing and mitigating the impact of the injuries should they occur.

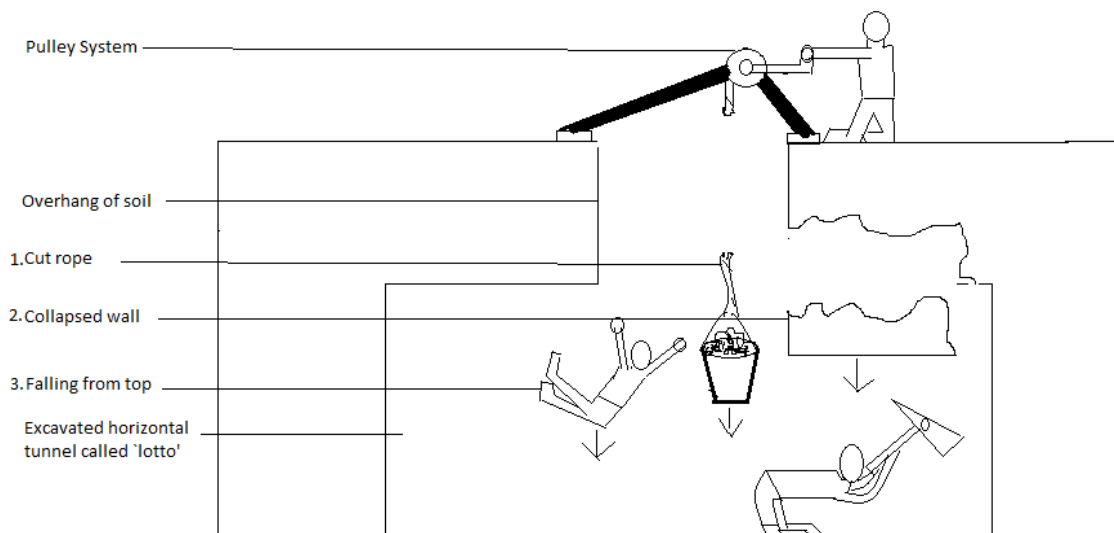


Figure 1: A schematic diagram showing a typical mining pit, the mining process and the different mechanisms (1, 2 and 3) by which spinal cord injuries at the site.

II. Materials and Methods

Our study was a retrospective study of all consecutive patients with traumatic spinal cord injury sustained at the mining site who presented to the Jos University Teaching Hospital, Plateau State, Nigeria from January 2018 to June 2020. There were 22 patients during this period.

Study Design: Retrospective observational study of all consecutive patients of all patients with traumatic spinal cord injury from mining accidents.

Study Location: Jos town is the capital city of Plateau state, North Central Nigeria. The city is located at an average height of 1295m above sea level with certain points as high as 1500m above sea level. The town is also called the 'Tin City' because of the discovery and mining of large deposits of tin ore in the region in the 20th century. The town is surrounded by high mountain ranges from which the state got its name Plateau state. The state had rich tin deposits in the then Jos province which includes currently five local government areas of Jos

North, Jos South, Jos East, Barkin Ladi and Riyom. The mining activities are concentrated in these five local Government areas.

Jos University Teaching Hospital is a 600-bed tertiary health facility located in Jos city providing services to the host community and surrounding states and serving as a referral centre for specialized care including Neurosurgery. Thus, patients who sustain spinal injury from mining accidents and who decide to seek orthodox medical care would most likely present to our facility either directly or by way of referral. Our facility can be accessed within one hour by road from the farthest of these areas.

Study Duration: From January 2018 to June 2020

Sample Size: Twenty two (22)

Sample size calculation: This was a total population sampling

Subjects and selection method: The subjects selected for the study were all patients presenting to the Jos University Teaching Hospital with spinal cord injury sustained from mining accident between January 2018 and June 2020.

Inclusion criteria: All patients irrespective of age or sex with spinal cord injury sustained as a result of a mining activity and presenting between January 2018 and June 2020.

Exclusion criteria: Patients with incomplete records.

Procedure Methodology: Data of interest were retrieved from the case notes of the patients and entered into a data extraction tool. Their demography, mechanism of the injury, clinical presentation, imaging findings and the immediate outcome of their management were the parameters of interest.

Statistical Analysis: The data from the data extraction tool were inputted into SPSS version 26 and descriptive statistics obtained. Categorical variables were expressed in proportions and percentages, while age was summarized as mean plus standard deviation.

III. Results

There was a total of twenty-two patients within this period. Of these, only nineteen (19) had complete records and these were the ones used for analysis. Eighteen out of nineteen (94.7%) were males. The mean age was 30.79 ± 7.32 years. Mining was the primary and only source of income in 42.1% of the patients, whilst the remaining used mining as an additional source of income. All the patients belonged to the low socioeconomic class. The most common mechanism of the injury was a collapse of the wall of the pit on the patient (68.4%). Other mechanisms included an ore loaded bucket falling on the patient (15.8%) and the patient falling into the pit (10.5%). Most of the patients (57.9%) were rescued by fellow artisans by pulling the patient out of the rubble and carrying the injured individual out of the pit, sometimes on their shoulders. Six (31.6%) had associated injuries involving one of these areas: the face, abdomen, brain or limb fractures. In 15(78.9%) of the patients, the injury was a complete spinal cord injury and in 4(21.1%) patients, it was an incomplete spinal cord injury. The thoracic region was the most commonly affected part of the body 14(73.7%), whilst the cervical and lumbar areas had 3(15.8) patients each. Only one of the patients could afford investigations and have surgical management: the remaining opted for non-surgical treatment. None of the patients came for follow up.

Table 1. Shows a summary of the results of the parameters evaluated.

s/no	Parameters	Results				
1	sex	MALE 18(94.7%)			FEMALE 1(5.3%)	
2	Age(years)	Mean = 30.79 ± 7.32 ,			Range 18 - 42	
3	LGA	Jos South 9(47.4%)	Barkin Ladi 6(31.6%)	Riyom 2(10.5%)	Jos East 1(5.3%)	Bassa 1(5.3%)
4	Mining as source of income	Full time 8(42.1%)			Part time 11(57.9%)	
5	Mechanism of injury	Collapse of wall of the pit on the patient 13(68.4%)			Bucket falling on patient 3(15.8%)	Fall into pit 2(10.5%) Unexplained 1(5.3%)
6	Part of the spine injured	Thoracic 12(63.2%)			Cervical 4(21.1%)	Lumbar 3(15.8%)
7	Severity of spinal injury	Complete(severe) 14(73.7%)			Incomplete(partial) 5(26.3%)	
8	Associated injuries	No associated injuries 13(68.4%)			Facial 3(15.8%)	Abdominal 2(10.5%) Limb fractures 1(5.3%)
9	Number who could afford full (CT/MRI) investigations	Afford 6(31.6%)			Not afford 13(68.4%)	

10	Number requiring surgery	Surgery 14(73.7%)	Not requiring surgery 5(26.3%)
11	Number who afforded surgery	No 12(85.7%)	Yes 2(14.3%)
12	Follow up	NIL	

IV. Discussion

Solid mineral mining like many other professions comes with its occupational hazards. Mining has been described as one of the most perilous and hazardous occupations in the world^{5,7}. These hazards are reduced when such tasks are carried out by trained personnel using appropriate equipment with the mining pits supported by pillars and struts that prevent the walls of the cave from collapsing on the miners. These safety measures are clearly absent in our cohort of patients. The international labour organization⁷ in their occupational health and survey of November 2004 described an ugly trend in which children were trafficked to the mine sites in Jos (the study area). Our results however, showed a predominance of young adult males of average age of 30 years with the youngest being 18 years of age and did not encounter children below 18 years amongst those injured and this may be due to the fact that we did not set out to profile all persons involved in tin mining, but only those who sustained spinal cord injury from the mining activities. The males by our culture are expected to be the breadwinners of their families or contribute significantly to the upkeep of the home where they are still staying with their parents. This may explain why almost 95% of our patients were males. The high demand and good financial returns for their products (tin) pushed these young persons to engage in these activities though they are aware of its illegality and the risks associated with the job⁷.

Our results also show that most of the patients that sustain a spinal injury from mining sustain the severe form of the disease (complete spinal cord injury). A patient with a complete spinal cord injury has a very poor chance of achieving a significant neurological recovery. When they sustain these injuries, there is a delay in presentation to a facility where their injuries can be managed. Some of the patients that sustain these injuries visit bone setters in the belief that the bone of the back is broken and that the traditional bone setters can 'fix' it. Two of our patients who required surgical intervention chose to visit these traditional bone setters when the prognosis was explained to them. The patients are usually transferred from the mining sites using motorcycles, tricycles or commercial vehicles with the patients usually in the sitting or reclined position with relations supporting them. This of course can worsen the severity of the spinal injury and can convert an incomplete spinal cord injury into a complete one. There is also a delay in presentation this can be caused by several factors of some including delay in accepting to come to a hospital, financial constraints, delay in referral from the initial facility where patient was first taken to. The fact that most of the patients present with complete spinal cord injury means that they have very little or no chance at all of achieving any meaningful neurological recovery. Thus, the deficits they present with were likely to remain permanent. In addition, this group stands a risk of developing secondary complications from the injury such as chest infections, respiratory failure, urinary tract infections especially those with cervical spinal cord injury. Those with incomplete spinal cord injury are the ones who stand a better chance of recovery, but delay in presentation and financial constraints are the major landmines on their path to achieving the recovery. These miners who are in the informal sector do not have insurance cover to cater for emergency services especially where there is need to have surgical intervention. The end result is that these patients present to our facility and go home with little or no change in their status. They also fail to turn up for follow up largely because they get to understand the prognosis and feel that orthodox medicine is unable to make them get back to their feet again

By way of recommendation, one would suggest

1. That Government or private institutions with the wherewithal take full charge of the mining sector, providing modern equipment required for the mining process. This would generally reduce the hazards associated with this industry.
2. These youths who are unskilled can be trained, given skills and then employed into the same industry, thus providing a means of livelihood for them.
3. The workers in this sector must have health insurance to cater for emergency and routine health needs.

V. Conclusion

Tin mining on the Jos Plateau resulting in spinal cord injury is an emerging occupational hazard affecting young men of the community leaving in its trail people with permanent disabilities. Government as a matter of urgency would need to step in to provide the necessary legislation, enforcement, skills, equipment and other facilities required for the safe running of such an industry.

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