

Natural Gas Deposits in Enugu; Case Series of Patients Who Sustained Flame Burns Following Mechanical Excavation of Underground Water Well in Enugu, Nigeria.

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ABSTRACT

Burn is a leading cause of major trauma world wide. Its severity is determined by the extent of the burns, its contact time and the presence of associated injuries. Occurrence of fire explosion during drilling of coalmines have been reported, however the occurrence of explosion associated with flame burns during mechanical excavation of underground well water is unique.

Methodology

This is a case series of patients who sustained flame burns from explosion during underground water well excavation in Enugu, Nigeria.

Implications to theory, practice and policy

This report of flame burning during water well drilling in Enugu emphasis the probable presence of coalbed methane(natural gas) in Enugu. This heightens the need for preventive measures during underground excavations in Enugu, Nigeria.

Keywords: Burn, explosion, coalbed, methane, Enugu, Nigeria

INTRODUCTION

Burn injury is one of the leading causes of severe trauma world wide, causing devastating injuries seen in the accident and emergency unit of hospitals¹. It is one of the major causes of mortality and morbidity in Nigeria. Worldwide, flame related burns were responsible for 238,000 death in year 2000, been the eighth commonest cause of death². The severity of flame burn is determined by series of factors which includes: the extent of the injury, its depth, contact time and presence of associated injuries.

Burn related injury from explosion in coal mines have been reported however not in our in environment (Enugu, Nigeria)^{3,4, 5}. The incidence of coal mine fires has been noted to have increased due to industrial revolution³. These explosions are as a result of coal bed methane (a natural gas) which is a companion gas of coal^{4,5}. The occurrence of flame burns during mechanical water well excavation in Enugu Nigeria is unique and raises fundamental questions which needs to be investigated and further occurrences prevented. These explosions suggest the presence of coalbed methane in Enugu, Nigeria. Enugu is known to have vast quantities of coal deposit.

There are no previous documented reports on occurrence of explosion following excavation of underground water wells during our literature search, as such this article will highlight its occurrence especially in a community with rich coal deposits.

METHODOLOGY

This is a case series of patients who sustained flame burns from explosion during underground water well excavation in Enugu, Nigeria.

Case one

47year old man who he sustained burns while digging a water well at Onu Asata in Enugu, Nigeria. He was at about 70ft depth when his drilling tool caused a spark as it hit a rock which resulted in an explosion with flames engulfing him for a few seconds. He had breathlessness for about a minute, but no loss of consciousness. He was eventually rescued by his co-workers about 5 minutes later. He was rushed to the emergency unit of National Orthopaedic hospital Enugu where he was assessed and noted to have sustained burn injuries to his face, both upper limbs, trunk and right thigh with associated severe pain amounting to 51% total body surface area (TBSA) mainly deep partial thickness with Inhalational component. He was resuscitated and managed according to the hospital burns treatment protocol but eventual died after 3weeks on admission from sepsis.

Case two

27year old manual worker who sustained flame burns to face and upper limbs at Emene In Enugu, Nigeria. He was excavating an underground well using electric powered machine with no safety gears when he noticed sudden explosion with flame which lasted a few seconds. He was helped out of the well by his colleagues. He could not estimate the depth of the well. He had no respiratory symptoms. Following presentation, assessment was made from history and physical examination. Assessment showed had sustained 7% mainly superficial partial thickness injury. Appropriate treatment was instituted according to the hospital protocol and he made uneventful recovery. He was discharged from the hospital after 10 days.

Case Three

35years old male manual labourer who presented at the accident and emergency unit of the hospital with 21 hours history of flame burns. This happened at Nike, Enugu Nigeria. He was excavating an underground water well with an electric drilling device when he noticed a spark with associated flame and explosion. He sustained burns to the upper limbs, anterior trunk and the face in the process. He was quickly helped out of the well by his colleagues who offered local first aid. He estimated that he was at a depth of about 13feet underground. Following assessment through history and physical examination, it was noted he had sustained 27% mainly superficial partial thickness burns. He had no other medical comorbidity. He was resuscitated and managed based on the hospital burn management protocol. He had complete wound healing by the third week of admission and was discharged to the outpatient clinic.

In the cases presented above, no personal protective nor preventive devices were used by the patients and they did not have a gas detecting device during the excavations.

DISCUSSION

Coal mine fires

Coal mine fires are often insidious and relatively common as the presence of coal itself, its impact on human health is not yet well characterized³. A 5–15% combination of methane and air is known to be explosive^{6,7,8,9}. Presence of fires below the surface coal deposits are known to be a natural phenomenon³.

Coalbed methane (CBM)

Coalbed methane (CBM), is a type of natural gas found in coal deposits⁴. Coalbed methane is produced following coalification process^{3,4,6}. This process involves the transformation of the complex biological and molecular structures in the cells of plants into the chemical fragments and structures observed in coal that gets adsorbed on coal at significantly high pressure⁴. Presence of CBM in underground mine poses a significant risk for fire and explosions^{3,4,5,6,10}. Santosh et al noted that with regards to the ignition sources, approximately 86% of the explosion was caused by blasting work, spontaneous heating, and frictional heat⁷. This is in keeping with the mechanism of the explosion in our patients which resulted from friction. The coalbed methane, often lies at low depths^{3,4,6}.

Location of coal bed methane in Enugu, Nigeria.

In Nigeria, large coal deposits are found across the country, particularly from the southern to the northeastern regions⁶. The Onyeama coalbed methane mine is situated on the western edge of the Cross river plain and is dominated by the Enugu escarpment just west of the town⁴. Abu et al noted that for the first 122 – 152m, the escarpment is steep, but it then rises more gently to about 427m above sea level and about 183m above Enugu⁴. The field is located within the coordinates long 7° 27' E, Lat 6° 29' N; Long 7° 25' E, Lat 6° 25' N; Long 7° 29' E, Lat 6° 25' N; Long 7° 29' E, Lat 6° 22' N covering area of about 4013.853 Hectares of land according to Abu et al⁴. This covers the location of the presented clinical cases. There is a decline in CBM emission in Nigerian coal mines which is attributed to the shutdown of most of Nigerian coal producing mines^{4,5}. The coal deposits in Nigeria are characterized by shallow depths, sub-bituminous rank, low ash content, and high volatile matter, this supports the mechanism of injury of our patients⁶.

Geological analysis of coal bed gas in Enugu

Results of analysis from a study by Mba et al showed that series old coal deposits and oil shale in Enugu have the natural scope to produce gas¹¹. In their study, Onwuchekwa et al showed that the gas content in coal samples from Enugu as determined by the Meisner equation was in the range from 1.79m³/t to 4.74m³/t for Ehiandiagu in Enugu while 8.03m³/t to 18.62m³/t for Eha-Alumona also in Enugu. The Eha-Alumona coal seam show good potentiality of methane gas of economic viability. The depth of this seam (41-52m and 30-35m) for Eha-Alumona and Ehiandiagu respectively¹². Further more, their result showed that methane (91.29%-91.94%) is the dominating compound in the gas content with relatively lesser variation of ethane (4.99%-5.97%) and propane (1.98%-2.44%) for the coal samples¹².

Prevention of explosion during drilling/ mechanical excavation in coalbed

The use of ventilation and cooling devices are reported to help prevent explosion during mine/well drilling⁷. However, these devices are not readily available in our environment. The presented cases had no safety and preventive devices. There is need to educate stakeholders on safety measures in preventing further occurrences of the reported incidences. There is need for the government to introduce policies and regulations aim at enhancing safety during mechanical excavation of water wells in Enugu, Nigeria. The Occupational Safety and Health department of the Federal Ministry Of Labour and Employment are responsible for ensuring safety for workers in Nigeria. Their role is to inspect work places, investigate accidents and formulate policies that enhance the safety of workers.

LIMITATION OF THE STUDY

We did not carry out a geological analysis in presented cases as the authors do not have the necessary support. However, this opens up an opportunity for further studies to determine the exact gas responsible for the explosions.

CONCLUSION

There is a risk for fire related injuries during mining and mechanical water well excavation in Enugu, Nigeria. This is probably due to the presence of coalbed methane as Enugu has rich coal deposits. Its importance cannot be overlooked. Awareness and precautions must be taken to prevent further occurrence of excavation related burns.

Conflict of interest

The authors have no conflict of interest to declare.

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Consent

Informed consent was obtained from the patients.

Ethical Statement

Ethical protocol of the National Orthopaedic Hospital Enugu Nigeria, were followed in writing this article.

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