ORIGINAL ARTICLE

Does Improvised Waterbed Reduce the Incidence of Pressure Ulcers in Patients with Spinal Injury?

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ABSTRACT

Background: Pressure ulcers are lesions caused by unrelieved pressure over bony prominences, resulting in damage to underlying tissues. The etiology is multifactorial including prolonged immobility. They usually complicate spinal cord injuries with long periods of bed confinement. The use of bed replacements markedly reduces the incidence of pressure ulcers, but the unaffordability of these replacements in low-income countries has necessitated the need to explore cheaper alternatives. **Aim and Objective:** The aim of this study was to ascertain whether the use of our cheap and locally improvised waterbeds would reduce the incidence of pressure ulcers in patients on prolonged bed confinement due to spinal injury. **Methodology:** Over a 16-month period, 51 patients (age range 1-80 years) with spinal injuries were managed conservatively in our service using improvised waterbeds in 21 (41.2%), while using the regular hospital bed/foam in 30 (58.8%). Biodata, the time interval between injury and presentation to the hospital, nature of the injury, use of improvised waterbed and development of pressure ulcer, were collected, collated, and analyzed. Statistical significance was calculated with the Chi-square test. **Results:** Most were males (98%), in the age range of 21–30 years (25.5%), and due to fall from heights (35.3%). Of 21 patients who were managed on improvised waterbeds, 6 (28.6%) had pressure ulcers, and of the 30 who did not use the waterbed, 17 (56.7%) developed ulcers. The $\chi^2 = 3.9381$, while $P = 0.0472$. This difference was statistically significant. **Conclusion:** The improvised waterbed, which is much cheaper than the standard waterbed, was observed to have significantly reduced the incidence of pressure ulcers among our patients. Nonetheless, further studies would still be needed to confirm this observation.

KEYWORDS: Neurological deficits, plastic sachet, table water

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INTRODUCTION

Pressure ulcers are defined by the Department of Health as lesions caused by unrelieved pressure resulting in damage to the underlying tissue.[1] They usually occur over bony prominences and are classified by the degree of tissue damage observed.

The etiology of pressure ulcers is multifactorial. Pressure, shear, friction, moisture, and poor nutrition contribute directly to the physiological etiology of pressure ulcers. Other factors associated with the development of pressure ulcers include immobility and psycho-social factors, such as inadequate personal and financial resources and noncompliance with generally acceptable preventive measures.[2,3]

Spinal cord injuries which commonly result in prolonged periods of confinement in bed, especially with conservative treatment, could be complicated by pressure ulcers. Interventions to prevent pressure ulcers can be quite expensive but may be nothing compared to the satisfactory treatment of these ulcers once they develop. It is, therefore, important in ensuring that resources are targeted towards patients who are at high risk of developing these ulcers, in order to prevent them from developing.

Several scales have evolved in the numerous attempts to identify those patients at high risk of developing pressure ulcers in order to protect them. Most of these scales have been developed under different institutional practices in an ad hoc fashion, and it is unclear which of them is the most accurate. There is little evidence that using a pressure ulcer risk scale is better than clinical judgment.[4]

In our center, the norm is to use foam troughs on top of the regular hospital bed/foam for patients with spinal injury, creating holes in the foam over areas where the bony prominences abut, in order to allow these regions hang free of direct contact with the foam. Unfortunately, those who could not afford to buy extra foams for the creation of troughs were routinely nursed on the hospital bed/foam, turned fairly regularly, every 4 h.

Confronted with this situation, and coupled with a significant rate of pressure ulcers, our team resolved to try an indigenous local alternative that is clearly cheaper and, therefore, more readily affordable than the standard imported waterbeds. Our local alternative consists of sealed plastic sachets of regular table water (popularly called "pure water,") which are arranged inside plastic bags, with each plastic bag containing exactly 20 sealed sachets of water.

Each of our patients' beds accommodates 10 of these bags, and each bag costs N80. In other words, 10 of these 20-sachet bags cost N800, compared to N25,000 for the cheapest standard imported waterbed.

Grading of Pressure Ulcers

- Grade 1: Persistent discoloration of the skin including nonblanchable erythema, blue/purple/black discoloration
- Grade 2: Partial thickness skin loss involving the epidermis and dermis
- Grade 3: Full thickness skin loss involving damage or necrosis of subcutaneous tissue but not through the underlying fascia and not extending to the underlying tendon, bone or joint capsule
- Grade 4: Full thickness skin loss with extensive destruction and tissue necrosis extending to the underlying tendon, bone or joint capsule.[5]

Interventions done to reduce the incidence of pressure ulcers must, therefore, include preventive strategies to reduce the magnitude and/or duration of pressure (including shear and friction) between patients and their support surfaces (interface pressure).

This may be achieved by re-positioning (e.g. turning and re-positioning the patient in bed every 2–4 h) and use of pressure-relieving support surfaces such as cushions, mattress overlays, replacement mattresses or whole bed replacements.[6]

The cost of these interventions vary widely from as much as GBP30,000 (N7.5 million) for bed replacements to GBP100 (N25,000) for some foam overlays. As these may not be easily affordable especially in resource-poor countries (developing countries), other means (e.g. improvised water beds) need to be explored.

Methodology

This was a prospective study over a 16-month period from December 1, 2011 to March 31, 2013 conducted at Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State.

Sampling technique

Consecutive spinal cord injured patients admitted via the Accident and Emergency Unit within this period were recruited for the study.

Inclusion criteria

- Patients with spinal injury
- Admission through the Accident and Emergency Unit
- Patients managed conservatively without operative intervention for the spinal injury
- Willingness of patients (if they are fully conscious) or their relatives (if the patients are not fully conscious), or both, to accept either the routine hospital foam troughs - these were used, more or less as controls, or accept the use of improvised water beds.

The improvised waterbed is formed using sealed plastic sachets of regular table water arranged inside plastic bags, with each plastic bag containing 20 sealed sachets of water [Figure 1a-d].

Biodata as well as mechanisms of injury, time interval between the injury and hospital presentation, mode of conveyance to hospital, spinal level of injury, nature of injury, use of improvised waterbed, development of pressure ulcers, and other complications were collected. The nature of the injury was either complete or incomplete, using the Frankel grading.

Simple data analysis was done, and statistical significance was $P < 0.05$ using the Chi-square test.

Results

A total of 51 patients were studied and their ages ranged 1–80 years, with the highest incidence among the 21–30 year age range 13 (25.5%), followed by 51–60 year group 10 (19.6%) [Table 1].

Males accounted for 50 (98%) while there was one female (2%), giving a male: female ratio of 50:1. Most of the patients were semi-skilled craftsmen which accounted for 15 (29.4%) and included plumbers, masons, carpenters, electricians and welders, whereas 10 (19.6%) were commercial drivers/cyclists, 8 (15.7%) students, 8 (15.7%) traders, 2 (3.9%) civil servants, and the remaining 8 (15.7%) were dependents, farmers, and laborers. Majority18 (35.3%) presented 2–7 days after injury, and the mechanism of injury mostly falls from height which accounted for 18 (35.3%) [Table 2].

Most of the patients (50.9%) were brought to the hospital lying flat in a vehicle [Table 3].

Cervical spine was the most commonly injured region of the column 34 (66.7%), followed by thoracic (27.5%) and lumbosacral (5.9%), spines. Incomplete spinal cord injury was more common 26 (50.9%) than complete 23 (45.1%), and 2 (3.9%) had no neurological deficits. All the patients were managed conservatively with either Gardner-Wells tongs for the cervical injuries or postural reduction for the thoracic and lumbosacral injuries.

Improvised waterbed was used in 21 (41.2%), while 30 (58.8%) did not opt for the waterbed preferring rather to be managed on the regular hospital bed/foam.

Figure 1: (a-d) Plastic sachets of table water in bags forming improvised waterbed

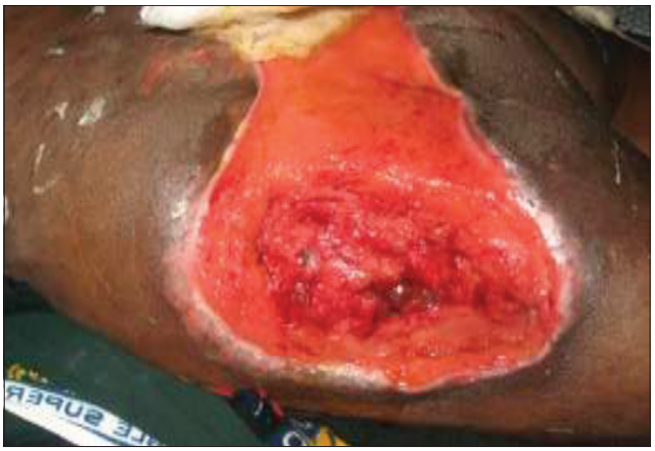

Figure 2: Healing pressure on a patient who did not use improvised waterbed

Table 1: Age distribution

Age (years)	Frequency (%)
0-10	1 (1.9)
11-20	5 (9.8)
21-30	13 (25.5)
31-40	8 (15.7)
41-50	9 (17.6)
51-60	10 (19.6)
61-70	4 (7.8)
71-80	1 (1.9)
Total	51 (100)

Table 2: Mechanism of injury

Mechanism	Frequency (%)
Fall from height	18 (35.3)
Passenger motorcycle RTA	15 (29.4)
Passenger motor vehicular RTA	9 (17.6)
Recreational sports	3 (5.9)
Pedestrian injuries	2 (3.9)
Spontaneous	2 (3.9)
Assault	1 (1.9)
Missiles/gunshot	1 (1.9)
Total	51 (100)

RTA: Road traffic accidents

Table 3: Mode of conveyance of the patient to the hospital

Mode	Frequency (%)
Lying flat in a vehicle	26 (50.9)
On a motorcycle	11 (21.6)
Sitting down in a vehicle	6 (11.8)
Tricycle	3 (5.9)
Unknown means	5 (9.8)
Total	51 (100)

Table 4: Use of improvised waterbed versus development of pressure ulcers

Variables	Improvised waterbeds	Regular hospital beds	Total
Pressure ulcers	6	17	23
Nil pressure ulcers	15	13	28
Total	21	30	51

Of the 21 who were managed on improvised waterbed, 6 (28.6%) had pressure ulcers while 15 (71.4%) did not; whereas, out of the 30 who did not use improvised waterbed 17 (56.7%) had pressure ulcers and 13 (43.3%) did not [Table 4 and Figure 2]. When it was subjected to statistical analysis, the $\chi^2 = 3.9381$, while $P = 0.0472$. This difference in development of pressure ulcers between those who used improvised water beds and those who did not was statistically significant.

Of the 23 with complete spinal cord injury, 11 (47.8%) were managed with improvised waterbed while 12 (52.2%) were not, and of the 26 with incomplete spinal cord injury, 16 (61.5%) did not use the improvised waterbed while 10 (38.5%) did. One (50%) of the two patients who had spine injury without neurological deficits used the waterbed, the other did not, but none of them developed pressure ulcers.

It could be observed from Table 5 that there were pressure ulcers in both the group of patients with complete and those with incomplete cord injuries; but when the difference was subjected to Chi-square test, the value was 0.1169, and $P = 0.5724$, implying that the difference was not statistically significant. While on admission, 9 (17.6%) had other complications which involved the respiratory (44.4%), digestive (22.2%), musculoskeletal (22.2%), and central nervous (11.1%) systems.

Discussion

Epidemiologically, the incidence of spinal cord injuries in this study correlated with published reports, with a male preponderance and most aged 15-40 years.[7] There were much more males than females affected in this series. Probably, the majority of cases resulting from fall from height could be

Table 5: Relationship between nature of spinal injury, use of improvised waterbed and development of pressure ulcers

Variables	Pressure ulcers	Nil pressure ulcers	Total
Complete cord injury	4	7	11
Incomplete cord injury	2	8	10
Total	6	15	21

a reflection of the nature of their occupations as most of them were semi-skilled craftsmen (which included plumbers, masons, carpenters, electricians and welders). These men had to climb some heights to ply their trades, e.g. at construction sites where high-rise buildings are being erected, and plumbing, electrification, ceiling and roofing had to involve climbing some heights, from where they fell.

This study was carried out in Nnewi, South-East Nigeria, a commercial hub, with poor road networks necessitating the use of motorcycles for transportation. It was no surprise that a good number of these patients (29.4%) had passenger motorcycle road traffic accidents, as well. This is slightly at variance with the etiological factors in some other regions of the world, including the southern part of Africa, as is typical of traumatic injuries.[8]

Despite the widespread attention to proper nursing and local wound care, pressure ulcers continue to pose a serious challenge to many physicians in diverse fields; and waterbeds have been known to prevent the development of pressure ulcers as well as hasten the healing of established ulcers.[9] This may, however, become a more serious problem in a developing country like Nigeria where most hospitals are unable to afford preventive measures such as overlays, air-fluid beds, and other devices like gel-filled mattresses currently in use in some other regions of the world.[10]

Among the patients in this study who were managed on improvised waterbeds, majority of them did not develop pressure ulcers, irrespective of the nature of spinal injury. When compared with those that did not use improvised waterbeds, more of whom developed pressure ulcers, the difference was found to be statistically significant, $P = 0.0472$. In other words, there were more chances of developing pressure ulcers without the improvised water beds and less chances of developing the ulcers with the use of the waterbeds.

Understandably, none of the patients with spinal injury but with no neurological deficit, who were still managed conservatively, developed any pressure ulcers, ostensibly because their confinement to bed did not connote inability to shift and turn in bed which portends prolonged sustained pressure over bony prominences.

The nutritional status on admission, interval before presentation and type of neurological injury may also be additional factors affecting the incidence of pressure ulceration.[11] Yet, what appeared to be the most influencing and possibly the constant factor in the incidence of pressure ulcers among the patients who had spinal injury with neurological deficits appeared to be the use of the improvised water bed.

Twenty-three out of the 51 patients treated within this study period developed pressure ulcers, and among these 23 cases, 74% of them were among those who did not use the improvised waterbed. And even among those with varying severities of neurological deficit, inasmuch as more ulcers were recorded in complete cord injuries than in the incomplete injuries, most of the ulcers in each of these groups were documented in those who declined the use of the improvised waterbeds than was otherwise the case. Nearly, 64% pressure ulcers were recorded in those with complete cord injuries who did not use the improvised waterbed and 80% ulcers were documented among those with incomplete injuries who did not use the beds. The constant denominator in all the groups, therefore, was the use or otherwise of the improvised waterbeds.

The implication of this observation is that the development of pressure ulcers in this series was not significantly affected by the nature of spinal cord injury, whether it was a complete or incomplete cord injury, provided that the improvised waterbed was employed. The statistically significant difference in the incidence of pressure ulcers only emerged with the use or nonuse of the waterbed, so long as a cord injury was already sustained, and not with the completeness or otherwise of the cord injury.

We are, therefore, compelled to note that the use of the improvised waterbeds among this series of patients with spinal injuries appeared to reduce the incidence of pressure ulcers, whereas the nonuse of the improvised beds appeared to have led to an increase in the incidence of the pressure ulcers. The protection conferred by the improvised waterbeds appeared to be independent of the region of the spine affected by the injury and also, not influenced by the severity of the neurological deficits.

Conclusion

The improvised waterbed, which is very affordable and much less expensive than the standard waterbed, was observed to significantly reduce the incidence of pressure ulcers in this series of cases, irrespective of the region, and severity of the spinal injury and neurological deficits.

Our waterbed could form a very important local alternative in reducing the debilitating morbidity and mortality from pressure ulcers in long-confined hospital patients, not least, those with spinal injuries.

On account of this observation, we advocate the urgent need to replicate and substantiate these observations by further studies from different clinicians and centers.

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