
A comparison of the spinal board and the vacuum stretcher, spinal stability and interface pressure

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The interface pressures were measured between the sacrum, mid-lumbar spine and various support surfaces. Thirty healthy male volunteers were recruited. The spinal board, padded spinal board and vacuum stretcher were the support surfaces evaluated. We found high and potentially ischaemic pressures between the sacrum and the spinal board interface (mean 147.3 mmHg). This was reduced in the padded board (115.5 mmHg) but dramatically reduced with the vacuum stretcher (36.7 mmHg). It was also noted that no support was given to the normal lumbar lordosis by the spinal board (padded and unpadded), but support was given by the vacuum stretcher. This raises the question of how stable is an unstable spinal injury on a flat supporting surface.

Introduction

Pressure necrosis is a significant problem in patients with acute spinal injuries. Insensate skin coupled with a low perfusion pressure places the tissues at risk (Reuler and Cooney, 1981). The incidence of pressure sores is around 40 per cent in those newly injured (Mawson et al., 1988). Patients with acute spinal injuries are turned frequently in an attempt to reduce the incidence of such complications. However, these patients are usually transported from the scene of their injury to the casualty department on a spinal board, and often remain on this or another flat surface whilst investigations and appropriate treatments are instigated. The time may be lengthened if transfer to a Regional Spinal Injury Unit is required. Workers have shown the incidence of pressure necrosis is positively correlated with time spent on the spinal board (Mawson et al., 1988).

There is a divergence of views as to the appropriate support surface used initially. Most European countries use the vacuum stretcher, but the UK and North America tend to use the spinal board. Discussion is underway to standardize this in accordance with EC recommendations (CEN, 1993).

The patient can be transferred by scoop stretcher on to either support surface just as easily. Both surfaces are regarded as radiolucent, allowing appropriate investigations to be undertaken without further movement of the patient from the support surface. No comparison studies have been made to evaluate differences in pressure characteristics of these two support surfaces, nor the degree of spinal support given to a normally curved spine by flat and conforming surfaces.

Materials and methods

The interface pressure of 30 healthy male volunteers was evaluated by means of the Talley Pressure Sensor (Talley, UK). The sensor was applied to skin overlying the spine at the level of the iliac crests and at the sacrum. The subjects were moved from the spinal board to the padded spinal board and then to the vacuum stretcher. The pressure sensor was securely fixed to the skin with medical tape to prevent its movement on transfer between surfaces. Readings were taken on all volunteers at the mid-lumbar and sacral sites on all three surfaces, immediately, and after 5 min, to allow for accommodation of tissues to the different surfaces. The subjects stood for 5 min after measurements on each surface. The heights and weight of each subject was measured to calculate Body Mass Index. The spinal board was a rigid plastic design as used on emergency vehicles on the Isle of Man.

A decision was made to see if interface pressure could be reduced by padding. A long roll of rim foam, 1 cm thick, was secured to a board by tape.

A full-body vacuum stretcher containing small polystyrene beads was also used. Air was extracted from this splint by means of a vacuum pump after the subject had been placed onto it. This caused the stretcher to conform rigidly to the subject's body profile once the maximum amount of air had been extracted. This was evidenced by the imprint of the subject's body on leaving the vacuum stretcher.

Results

The Body Mass Index was in the normal range for all subjects (20–25 kg/m²). A small drop in interface pressure over 5 min was found in all surfaces (2–12 mmHg). The mean values for the 30 subjects are shown in *Figure 1*. The difference in groups was evaluated using Student's *t*-test. The falls in sacral pressure between the spinal board and the padded board were highly significant ($t < 0.001$, $t = 4.15$ at 29 degrees of freedom) and also between the spinal board and the vacuum stretcher ($t < 0.001$, $t = 20.3$ at 29 degrees of freedom). The mid-lumbar pressure was 0 mmHg on padded and unpadded spinal board. An obvious gap was noted between the lumbar lordosis and the spinal board in all of our subjects. With the vacuum stretcher, the pressure range was 10–24 mmHg at 5 min, and the mean 16.7 mmHg, with the stretcher conforming to the lordosis.

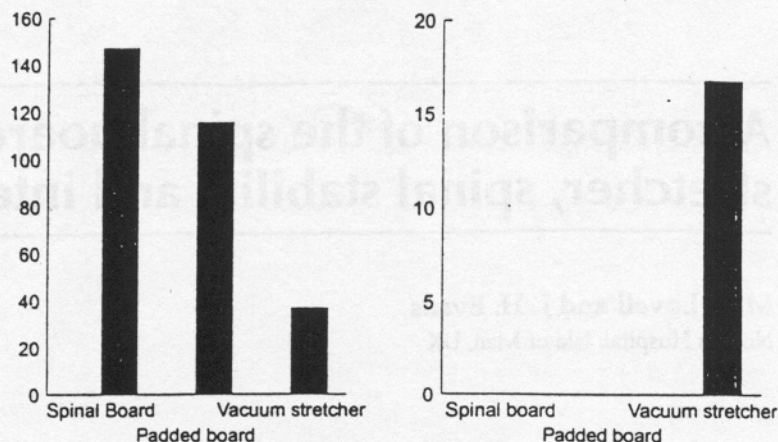


Figure 1. Recorded sacral and mid-lordotic pressures (mmHg).

The percentage reduction of interface pressure at the sacrum was therefore 21.6 per cent between unpadded and padded spinal boards and 75.1 per cent between spinal board and vacuum stretcher.

Conclusions

Our results indicate that the mean sacral interface pressure on a spinal board (147.3 mmHg) is above average systolic blood pressure (120 mmHg). Workers differ in their opinion as to an ischaemic pressure. Some suggest that tissue perfusion is compromised at pressures exceeding 35 mmHg (Williams et al., 1988), others feel that, due to neurally controlled accommodation, the pressures can be much higher (Guyton, 1981; Bader and Gant, 1988). However, in those patients with acute spinal injuries causing neurological deficit, there is relative hypotension and loss of such autoregulation. Therefore, the lowest interface pressure possible is beneficial.

In patients with acute spinal injuries not causing any neurological deficits, autoregulation of tissue perfusion will be normal but still cannot exceed systolic blood pressure.

The padded spinal board is not the answer; although its interface pressure is lowered (115.5 mmHg), the level of reduction is unlikely to aid tissue perfusion. However, the vacuum stretcher's mean sacral interface pressure (36.7 mmHg) is a very real reduction and more likely to be conducive to tissue perfusion and oxygenation.

The low sacral interface pressure of the vacuum stretcher is due to its surface conforming to the shape of the body, thus increasing the weight-bearing surface area. Our results show that the lumbar spine is unsupported on a flat surface, yet supported by a conforming surface. The human spine is a series of curves throughout its length. If there is an unstable spinal injury, supporting the spine on a flat surface rather than a conforming surface may cause stresses to be set up within the spine, leading to displacement or further displacement at the site of injury.

In patients with an acute spinal injury, emergency physicians are only too conscious of the need to handle the spine with considerable care as even controlled movement

may cause displacement of an unstable injury (McGuire et al., 1988).

We contend that a patient with an acute spinal injury should be transferred to a conforming support surface until appropriate investigations are complete. Managing a spinal injury in this way may reduce the incidence of pressure necrosis and the possibility of further neurological compromise. Whilst this hypothesis is unproved we consider it worthy of further investigation.

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