AN INVESTIGATION INTO EFFICACY AND COST EFFECTIVENESS OF USING THERMOCONTOUR MATTRESSES IN THE REDUCTION OF HOSPITAL ACQUIRED PRESSURE SORE PREVALENCE.

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Efficacy and Cost-Effectiveness of the Thermocontour Mattress

Abstract

Use of air mattresses in reduction of pressure sore incidence is an important part of quality patient care. However, there will never be enough air mattresses to match the demand as increased education and an increase in the general provision of air mattresses can lead to an unrealistic expectation of obtaining air mattresses when required for patients. This raises the demand for air mattresses and increases costs within hospital trusts. This study examined a way to redress the balance through use of an alternative, cost-effective type of mattress (thermoelastic polymer) in the prevention of pressure sores. Prime consideration was given to the comfort of the patient. The claims of the manufacturers, Barrington Healthcare, that ‘patients with Waterlow scores of 23 can be nursed safely on this product’ were explored as part of the study. A total of 407 patients took part over a 6-month period. Twenty-four Thermocontour mattresses were loaned to one ward for the study and patients were allocated to the mattress through admission to the experimental ward. Patients were then split into two groups on two wards. Group B were allocated to a Thermocontour mattress and group A were nursed on air mattresses and foam mattresses generally used throughout the trust. Results showed that more patients were comfortable on the Thermocontour mattresses than on all other mattresses. Patients with Waterlow scores under 25 did not develop pressure sores on the Thermocontour mattress. However, the sample of patients with a Waterlow score of between 20 and 25 was small and therefore further research is required.

The national incidence of pressure sores is between 6.7% (Department of Health, 1993) and 18.6% (O’Dea, 1993). As long ago as 1987, Hibbs stated that 95% of pressure sores were preventable. The 5% that were not preventable were the result of previous problems such as lying on the ground — sometimes for hours — following a fall. This was supported by Collins (1997), who demonstrated that the incidence of hospital-acquired pressure sores could be reduced from 5.2% to 0.3% on a medical elderly ward by the use of appropriate resources. Cullum et al’s (1995) systematic review recommends the use of appropriate resources such as pressure-redistributing foam mattresses in preventing or avoiding pressure damage.

The Department of Health (1993) asked district health authorities to ensure a reduction in pressure sores of 5–10% annually. The King’s Fund Centre (1988) identified three main factors involved in improving pressure sore prevention and management: the patients; the resources; and the knowledge required to improve standards of care.

The introduction of the tissue viability nurse specialists (TVNs) in acute care could potentially address these three issues through:

- Raising awareness of excellence in quality care through education
- Reduction of incidence/prevalence of pressure sores, through applying the ideals of clinical effectiveness in use of resources
- Ensuring that prevention is cost-effective.

Within Eastbourne NHS Hospital Trust there are 100 purchased air mattresses and over 300 pressure-relieving foam mattresses. Audits at the author’s trust over 3 years indicate that there are 110–150 patients in Eastbourne hospitals at high to very high
risk at any time of developing pressure sores, leaving a shortfall of air mattresses of up to 33%. This has a high cost implication for the trust in hiring necessary mattresses (Hampton et al, 1997).

A simple answer to the shortfall would be to purchase another 10–50 mattresses. However, the infection control policy in Eastbourne requires air mattresses to be sent away for cleaning following any contamination of resistant infections, which costs £68 per mattress, costing the trust between £5000 and £10000 per year. The cost of maintenance, which can be as high as £300–400 per mattress per year and cleaning makes the purchase of extra mattresses difficult and expensive. Therefore, the TVN must find alternative cost-effective and clinically effective methods of preventing pressures sores.

THE STUDY

An alternative to providing expensive air mattresses would be to identify a basic mattress that could be used to prevent pressure sores in high-risk patients. This would free air mattresses for those patients at high risk or with an established pressure sore and would provide quality, cost-effective care in prevention. Thermoeelastic polymer is foam with slow memory — the foam does not endeavour to retain the original shape — thereby relieving some of the pressure that comes from shape-retaining foam. The elastic polymer is sensitive to the heat of a patient’s body causing it to redistribute pressure along the length of the body and thereby moulding and cradling bony prominences, providing uniform pressure and removing ‘hot-spots’ of pressure. Once the pressure is uniform the amount of strain on the bony prominences becomes less urgent and the patient is at reduced risk of developing a pressure sore. There is also a possibility that shearing forces may be reduced in the seated patient as the ‘well’, produced by the heat of the body reshaping the elastic polymer, could hold the patient’s position and prevent the sliding movement that increases potential of shearing forces.

Eastbourne Hospitals NHS Trust has moved away from the traditional 2-hourly turns (Hampton, 1998), as patients who are acutely ill possibly require more frequent repositioning, and therefore 2-hourly turns do not prevent pressure sores in these patients (Table 1).

Repositioning should be for comfort or treatment, not primarily for prevention of pressure sores. Providing the patient is nursed according to the risk assessment on an appropriate mattress, repositioning can be adapted to the patient’s needs rather than the ritualistic requirements of the nursing care. Identifying an appropriate mattress, however, is a more complex issue, and obtaining a mattress may be difficult. When repositioning of the patient is unavoidable (when an appropriate mattress cannot be located), patients are nursed in the 30o tilt (a method of repositioning the patient without placing them on a bony prominence, i.e. slightly tilted with the use of pillows) (Collier, 1995). Repositioning times would be according to the assessment, i.e. any blanching hyperaemia on pressure areas when the patient is repositioned would indicate the need for increased repositioning times.

Barrington Healthcare, producers of Thermocontour mattresses, claim that patients with Waterlow scores (Waterlow, 1988) of up to 23 can be nursed safely on a Thermocontour mattress without developing pressure sores. The investigator wished to undertake a study to confirm this and to ensure that patients with Waterlow scores higher than 25 would not develop sores when nursed on thermoeelastic polymer foam. If patients of higher Waterlow scores could be safely nursed on these mattresses there
would be a possibility of reduced demand on air mattresses. This would release air mattresses for patients admitted with pre-existing pressure sore damage. Given that risk assessment systems are largely unproven in effectiveness, and the Waterlow score may overpredict the need for expensive systems, many patients may be being provided with unnecessary air mattresses — depriving other patients of essential resources. Therefore, to answer this dilemma, the TVN decided to review the new type of elastic polymer mattress as an alternative to air mattresses in some patients.

The TVN wished to establish whether Thermocontour mattresses (made of thermoelastic polymer) would:

- Reduce the requirement of air mattresses
- Offer comfort for the patient
- Be clinically effective in prevention of pressure sores
- Offer a cost-effective method of preventing pressure sores.

Barrington Healthcare was asked to supply 26 Thermocontour mattresses for the study over the 6-month period.

METHODS

Two wards (A and B) were selected for the study. Ward B was supplied with 26 Thermocontour mattresses and 26 Thermocontour chair cushions (Figures 1 and 2). Ward A continued to use the mattresses that belonged to the hospital, i.e. a selection of foam mattresses. Air mattresses were supplied to ward A according to the identified need from the Waterlow score. Patients admitted to ward B with a pressure sore or if blanching erythema became apparent were supplied air mattresses. Otherwise patients in ward B remained on the Thermocontour mattresses. Therefore, for simplicity, the patients were split into group B (those patients nursed on Thermocontour mattresses) and group A (those patients nursed on all other mattresses).

A questionnaire was devised to look at many parameters affecting the patient’s risk of pressure sore development (Table 2). Three issues were very important: Waterlow score; comfort; and pressure sore incidence.

The prime intention of the study was a comparison between types of mattress and their performance in prevention of pressure sores. Direct comparison was difficult, as ward A would receive many different types of mattresses over the study period. However, it was the investigator’s intention to assess whether patients were less likely to develop pressure damage on thermoelastic polymer. Direct comparison (placing patients of high Waterlow score on all foam mattresses) could not be ethically made as the hospital policy stated that patients of medium to high risk should be nursed on an air mattress, not on a foam mattress designed and purchased particularly for low to medium Waterlow scores.

The methodology was simplistic in design and the aim was to identify comfort of the patient, any pressure sores that developed on the Thermocontour mattress and cost-effectiveness.

Within Eastbourne hospitals there is a proactive admissions ward where patients are assessed and pressure-relieving equipment provided, if possible, before transfer to the main wards. Therefore, patients, having been assessed on the admissions ward as requiring an air mattress were likely to be admitted to a Thermocontour mattress ward (group B) with the air mattress supplied, as mentioned above. It was thought important (ethically) that these patients should remain on the supplied air mattress on
admission to the main ward. However, this affected the study because those people were lost to the thermoelastic type mattress group.

PATIENT PROFILE

Both groups included acute medical patients of all ages. Diagnoses of patients in both groups included cardiovascular disease, diabetes, cerebrovascular accidents and multiple pathology. A Waterlow risk assessment was carried out on each patient on admission to the two groups. The ward staff were educated by the investigator in how to observe patients for blanching hyperaemia, as this was to be used to identify when patients required a higher-grade mattress (i.e. dynamic air mattress). Blanching hyperaemia is an area of redness which, when lightly pressed with a finger, will blanch white and then return — through reactive hyperaemia — to redness again. If used for assessment purposes, this stage can identify that the patient is nursed on an inappropriate mattress (Collier, 1995).

PATIENT INCLUSION CRITERIA

All patients without pressure damage and with a Waterlow score of 25 or less were included. The following patients were excluded from the study:

- Patients who refused to take part (or refusal by next of kin)
- Patients with an established pressure sore
- Patients with a Waterlow score greater than 25 (where possible these patients should be provided with an air mattress).

DATA COLLECTION

One person employed specifically for the study collected the data. The data collector was not a nurse and collection of data relied on interviews with patients, nurses and professionals allied to medicine. Six hours a week was spent collecting the data. Data were entered onto an Excel database.

RESULTS

A total of 407 patients were included in the study, with 199 patients on Thermocontour mattresses (group B) and 208 on all other mattresses (group A). The age range was 20–102 (mean 75) (Table 3).

Clinical effectiveness in the prevention of pressure sores. Of the 42% of patients with Waterlow scores greater than 15, none developed a pressure sore. Waterlow scores of patients nursed on Thermocontour mattresses ranged from <10 to 33 (Table 4; Figure 3). Of these patients, nine had a Waterlow score greater than 25 (these patients should have been excluded from the study, but were included out of necessity as an air mattress was unavailable). Figures 4 and 5 show a comparison between Waterlow scores on Thermocontour mattresses and those on all other mattresses. All patients were followed until discharge from the ward.
MATTRESSES USED DURING THE 6-MONTH STUDY

A total of 48.9% (199) of all the patients were nursed on Thermocontour mattresses. Of the 208 patients nursed on other mattresses:
- 5.3% (11) were nursed on air mattresses
- 29.3% (61) were nursed on pressure-reducing foam mattresses
- 30.3% (63) were nursed on NHS standard mattresses
- 35.0% (73) were nursed on overlays (cut foam).

COST-EFFECTIVENESS

During the 6-month period before the study, 31 patients were identified as being at risk on ward B and were allocated air mattresses. During the 6 months of the study only 11 patients were identified as requiring air mattresses on ward B. This represented a 64% reduction in the use of air mattresses. It would be difficult to make an exact cost analysis. However, given that at least four of those mattresses would require decontamination following bacterial contamination (costing £272), and cost of maintenance is approximately £300–400 per mattress per year, there is a potential cost saving of £3272 over the 6-month period on one group.

PATIENT COMFORT

Patients were asked to comment on the comfort of the mattress. A total of 88% of patients nursed on a Thermocontour mattress said they were comfortable or very comfortable compared with 65% on other mattresses. A total of 26% were very comfortable on the Thermocontour compared with 2% on the other mattresses. Table 5 shows the various comments made about Thermocontour mattresses. Twelve per cent (23; n=199) found the Thermocontour mattress uncomfortable compared with 46% (96; n=208) on all other types of mattresses. The main complaint appeared to be the sheets slipping on the cover of the Thermocontour. Three nurses commented (anecdotally) that patients could not move easily on the Thermocontour mattresses. The action of the foam was to mould to the body shape and this produced a ‘well’ that limited the movement. However, this was not identified or borne out by the patients’ reports. Physiotherapists did not identify problems when mobilizing patients from the Thermocontour mattress and the patients appeared well supported. Two cardiac resuscitations were conducted on the Thermocontour mattresses without difficulty during the 6-month period. The Thermocontour mattresses were easily cleaned with soap and water.

Several issues became apparent during the study period. As stated earlier, patients assessed on the admissions ward often arrived on the study ward with an air mattress in situ. This greatly reduced the amount of high-risk patients (Waterlow 25) who would have been nursed on a Thermocontour mattress and could have skewed the results. However, it would have been unethical to remove the patient from the mattress when it was identified as required and already in use. Therefore, it was difficult to establish cost-effectiveness through this method. However, the check on mattress use over the 6 months before the study demonstrated that there had still been a large cost saving with a potential of reducing future use of air mattresses.
It would be unethical to place a patient with a large, established pressure sore on a foam mattress as hospital policy dictates that all patients with a pressure sore greater than grade 4 must be nursed on a replacement air mattress (Torrance, 1983). Therefore, the effectiveness of the mattress in promotion of healing sores could not be established through this study.

PRESSURE SORE DEVELOPMENT

No patients developed pressure sores on Thermocontour mattresses. Between the two groups, eight were admitted with pre-existing pressure sores and six were hospital acquired (Figure 6).

The comparison between the types of mattresses demonstrates that the Thermocontour mattress was thought to be the most comfortable. However, there was not a direct comparison between types of mattresses and the Thermocontour and the study looked at all types of mattresses in the trust, including some NHS standard mattresses. A direct comparison between the NHS standard mattress and any other mattress may have produced similar results.

A further study in thermoelastic polymer could be made using a randomized controlled trial methodology, with a full-time, qualified nurse to produce data from 100% patient inclusion. Patients would be admitted to the ward directly onto a Thermocontour mattress and progress followed through to discharge.

This study showed that it is likely that patients will not develop pressure sores when nursed on a Thermocontour mattress when the Waterlow score is under 25. However, the number of patients with a Waterlow score over 20 nursed on Thermocontour mattresses was limited (i.e. 13) and therefore little significance could be drawn. Thermocontour mattresses could be a proactive solution to the problem of expensive resources. When a good basic mattress with a pressure-redistributing potential of the Thermocontour mattress is used, pressure sore incidence may decrease and the need for expensive equipment may be reduced. Therefore, given that the pressure sore rate found on Thermocontour mattress in this study is zero, it would be cost-effective to supply the patient with a Waterlow score under 25 a mattress and cushion on admission. This is likely to reduce costs in the hospital situation where the care is often reactive, i.e. patients are placed on an air mattress because they have developed a break in the skin. Fewer air mattresses will be required, thereby reducing hiring and purchase costs.

Nurses using the thermoelastic foam mattresses (Thermocontour) stated that they believed that the mattresses had saved them time through reduced amount of time spent repositioning patients, and as patients were less likely to slip down the bed, it reduced the amount of times patients were sat up.

STUDY LIMITATIONS

One limitation of the study was the time allocated for data collection. Three hours twice a week meant that the data collector missed many patients who were discharged home or transferred between wards. Any further studies should support the involvement of a full-time data collector. Another limitation of the study was the inability to control the type of mattress the patient was given before admission to the experimental group. Future studies should control mattress supply to enable higher accuracy in assessment.
CONCLUSION

The study highlights the need for further research to assess the cost-effectiveness. To undertake this work, the limitations of this study should be considered. A future study could audit the use of air mattresses and prevalence of hospital-acquired pressure sores, to establish the cost-effectiveness and clinical effectiveness of thermoelastic polymer foam mattresses.

The investigator would like to replace all basic mattresses with Thermocontour within Eastbourne Trust, and to undertake a further study to include assessing patient risk of developing sores by observing for blanching hyperaemia. Every patient requiring a pressure-redistributing/relieving or pressure-reducing mattress requires the same pressure-relieving standard in seating/cushions, regardless of Waterlow score. The mattress and cushion should be supplied as a package.

This mattress study was useful to the investigator as it provided evidence of patient comfort on thermoelastic type mattresses, and indicated there may be cost savings to be made through the purchase of this type of mattress.
KEY POINTS

- Risk assessment tools can overpredict equipment requirements, leading to poor allocation of scarce resources.

- Assessment of patients’ pressure areas and identification of blanching erythema may lead to more appropriate use of resources.

- Proactive allocation of appropriate basic mattress may reduce expensive equipment requirements.

- Skilful assessment and identification of appropriate mattress requirements can reduce repositioning times, leading to high quality care and patient comfort.

- Patients should be provided with pressure – reducing mattresses and cushions on admission to the hospital.
Tables

Table 1: Important considerations in repositioning patients

- How much pain they may experience when repositioned
- Whether they wish to be repositioned
- Repositioning may physically harm critically ill patients
- Friction forces can cause tissue damage when repositioning
- Repositioning disturbs sleep
- Repositioning may be necessary for treatment
- Appropriate posture for eating meals

<table>
<thead>
<tr>
<th>Parameters affecting pressure sore risk</th>
<th>Age of patients</th>
</tr>
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<tbody>
<tr>
<td>Waterlow score</td>
<td>Group A</td>
</tr>
<tr>
<td>Continence status</td>
<td>Mean</td>
</tr>
<tr>
<td>Medication</td>
<td>Median</td>
</tr>
<tr>
<td>Dependency</td>
<td>Mode</td>
</tr>
<tr>
<td>Development of pressure sores</td>
<td></td>
</tr>
<tr>
<td>Grade of sore</td>
<td></td>
</tr>
<tr>
<td>Nutritional status</td>
<td></td>
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<tr>
<td>Mattress</td>
<td></td>
</tr>
<tr>
<td>Comfort</td>
<td>Mean</td>
</tr>
<tr>
<td>Ease of movement on the mattress</td>
<td>Median</td>
</tr>
<tr>
<td>Ease of standing up from the mattress</td>
<td>Mode</td>
</tr>
</tbody>
</table>

Table 4: Waterlow scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>14.6</td>
<td>12.8</td>
</tr>
<tr>
<td>Median</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Mode</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 5: Comments on the Thermocontour Mattress

Positive comments
- Best mattress I’ve ever slept on
- Lovely and comfortable
- Definitely an improvement from when I have been a patient in the past
- No sores - unlike when previously in hospital
- Been a patient many times and this is the best mattress yet
- Like the way it moulds to the body
- Brilliant
- Very comfortable
- Better than the one I have at home
- Superb
- Been in hospital many times and find the mattress excellent
- Beautiful
- Been a patient over 2 months, the mattress is excellent and I do not have sores
- Superb, superb
- Just right – not too hard, not too soft. I’m a heavy man and find it extremely comfortable

Negative comments
- Too hot
- Too firm – did not sleep well
- Too soft
- Nothing exceptional
- Worst mattress I’ve ever slept on
- Don’t like the way it moulds to the body
- A little slippery
- Very hard
- Not as comfortable as home
Breakdown Of Waterlow Scores: Patients Nursed on Thermocontour Mattresses

42% of Patients Treated On Thermocontour Mattresses had Waterlow Scores Greater than 15

No Patients Developed Pressure Sores Whilst On Thermocontour Mattresses

Figure 3

Waterlow Distribution: Thermocontour Ward & Control Ward

Figure 4
20% of patients nursed on the Thermocontour mattresses were in the very high risk category and 22% were in the high risk category. Of the 42% of patients with Waterlow scores above 15, NO patients developed pressure ulcers.
Hibbs P (1987) Pressure Area Care for the City and Hackney Health Authority. St Bartholomew’s Hospital, London

For further information and list of distributors please contact Barrington Healthcare International, BCM Box 5526, London WC1V 6XX. Tel: 0207 629 5528; Fax: 0207 629 9787.

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