Aids to prevent pressure sores

John B Young

Pressure sores are a potentially preventable complication of immobilising illnesses. They can be painful and distressing to the patient and may necessitate long periods in hospital. They are expensive: treatment of pressure sores costs the NHS an estimated £150 million a year.¹ Although treatment of the established sore is important, methods of prevention should be our main concern. Vulnerable patients must be identified and appropriate nursing methods and equipment selected. I have concentrated mainly on beds and mattresses, but all surfaces on which patients sit or lie, including easy chairs, wheelchairs, casualty trolleys, and operating tables,² need attention.

Mechanisms of pressure sore formation

Pressure sores originate deep within subcutaneous tissues. The body can withstand high pressures if uniformly applied (such as for deep sea divers) but local (point) pressure and shearing forces produce tissue distortion and so impair or occlude capillary flow producing ischaemia (fig 1). The standard NHS hospital mattress can produce point pressures of up to 150 mm Hg. Ischaemia is likely to develop if the normal capillary pressure of 12-33 mm Hg is exceeded for long enough. Critical capillary pressures may be lower in debilitated or elderly patients. Friction, a component of shear, may contribute separately to pressure sores by stripping superficial skin layers, leading to ulceration.

FIG 1—Unstressed subcutaneous tissue (left); deforming effects of point pressure (centre); and shear (right)

Preventing pressure sores

Prevention begins with good nursing care. Attention to hydration, nutrition, and skin care are important, and regular frequent turning will restore subcutaneous perfusion. These measures are enough for most patients but patients at high risk of pressure sores also require special pressure relieving surfaces. High risk patients should be identified by routine use of one of the available prediction scales³—for example, the Norton score (table). In general, elderly patients and

patients who have impaired consciousness or who are bed or chair bound, especially if spontaneous movement is reduced,⁴ are most at risk.⁵

Pressure relieving surfaces

The dominant principle is that the supporting medium should mould around the body, providing equal pressure over the largest possible areas thereby eliminating point pressures and tissue distortion. There needs to be enough depth so that the bony prominences do not “ground” on to the hard mattress base. Realising that the most advanced pressure relieving devices can be seriously undermined by tightly tucked in bedding, which produces a “hammock” effect with concomitant high pressure, is also important. Selecting a pressure relieving surface primarily entails an understanding of the degree of protection that a particular surface will provide. Other considerations are ease of use and maintenance, ease of nursing procedures including moving and transferring patients, patient acceptability, and cost.

SUPPLEMENTS TO STANDARD MATTRESSES

The pressure relieving characteristics of the standard NHS mattress, especially when covered by a waterproof sheet, are poor and can be improved by a range of additional products. Sheepskin fleeces can be used to reduce shear and to improve vapour loss, which helps keep the skin dry. Natural fleeces are considerably better at both these functions than synthetic products,⁶ but are more expensive (about £18 compared with £10). The physical properties of any type of fleece are impaired when overlaid by sheets or clothing and if matting occurs due to poor laundering. Various types of bootee are available to protect the heels, which are a particularly vulnerable site for pressure sores in elderly patients with a fractured neck of a femur. A gel pad cushion has proved effective for protecting the sacrum, even during traction.⁷

Padding mattresses (fig 2) containing polyester fibres (for example, Spenco or Polycare) laid on top of a standard mattress are probably as effective as ripple mattresses, especially for elderly people, but confer only a modest degree of extra protection and should not therefore be relied on for those patients judged to be at considerable risk of pressure sores.⁸ They are easier to use than ripple mattresses and are maintenance free but should be replaced after two to three years. Also of proved effectiveness is a polystyrene bead bed system for use on trolleys and theatre tables as well as hospital mattresses.⁹ It produces an instant three dimensional mould of the body contours so reducing point pressure and tissue deformation.

FOAM MATTRESSES

The Vaperm is the best studied mattress in this group. It is constructed from five types of fatigue resistant polyethylene foams each of varying densities laid together with pressure relieving and ventilation channels to produce a composite structure. The primary mattress cover is a thin washable or disposable polyurethane film that readily conforms to body indentations and is also waterproof but vapour

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Norton score, for assessing degree of risk of developing pressure sores, developed for use with elderly patients. Score of ≤ 14 indicates vulnerability to pressure sores and score of < 12 high risk

Physical condition	Mental state	Activity	Mobility	Incontinence
Good (4)	Alert (4)	Ambulant (4)	Full (4)	None (4)
Fair (3)	Apathetic (3)	Walks with help (3)	Slightly limited (3)	Occasional (3)
Poor (2)	Confused (2)	Chairbound (2)	Very limited (2)	Usually urine (2)
Very bad (1)	Stuporous (1)	Bedbound (1)	Immobile (1)	Double (1)

FIG 2—Padding overlay supplement to standard mattress; confers only modest degree of extra protection

FIG 3—Airwave system (Pegasus): easy to use and suitable for high risk patients

permeable so preventing excessive skin moisture. This mattress is fairly cheap (£135), particularly when it is compared with a standard NHS mattress plus a padding supplement mattress or ripple mattress. Use and maintenance is also easy. Adequate ventilation requires an open mesh bed base—not the solid sheet of the King's fund bed. The pressure relieving characteristics are considerably superior to those of the standard hospital foam mattress.¹

RIPPLE MATTRESSES

Ripple mattresses consist of tubular air filled cells, each of which is alternately inflated and deflated. Critical tissue ischaemia is therefore prevented by the vulnerable body pressure points being subjected to alternating short periods of high and low pressures. It is laid on to the standard mattress and connected to a pump unit and time switch. Several types of ripple

mattress are available, but those with larger diameter cells (10 cm) are better as the smaller (5 cm) cells do not provide adequate support and may allow "grounding" to occur. This factor probably excludes the use of the even smaller "bubble pad" mattresses for which there is no proof of effectiveness.

The large cell ripple mattress is simple and effective,¹⁰ but their use has been marred by poor reliability.¹¹ In a recent study 45 ripple mattresses required 52 repairs of motors and 90 repairs of material during 12 months.⁸ Constant vigilance and a routine maintenance programme are essential to ensure correct functioning. If the cells fail to deflate constant high tissue pressures occur thereby increasing the risk of pressure sores. A simple check is to ensure it is possible to reach under the patient via the deflated cell. Failure of the red warning light on the motor unit to go off indicates low pressure and a probable puncture. The tubing coil leading to the motor is easily kinked or obstructed, again causing malfunctioning of the mattress.

AIRWAVE SYSTEM

This is a more complex air cell type bed (fig 3). It has two layers of air cells rather than one, which are laid together as vertical pairs so providing up to 20 cm depth. Pressure is alternated by deflating every third cell in turn, each cycle lasting seven and a half minutes. The mattress should be covered with a washable fleece that disperses a continuous flow of air from numerous pin holes in the air cells and ensures that the patient's skin remains dry. The air holes should not be obstructed by plastic draw sheets. The power unit is fairly quiet and easy to operate with the pressure set automatically and an audible malfunction alarm. In use the air cell mattress is simply laid on to a standard hospital bed base. The spaces left by the deflated cells make easy access for lifting and turning the patient. The large cell diameter enables the patient to sit semi-recumbent without excessive shearing forces on the buttocks. The system is considerably more effective than a large cell ripple bed,¹² more robust and reliable, but is 20 times more expensive (£2350).

AIR SUPPORT SYSTEMS (FIG 4)

These are expensive and complex pressure relieving systems (£7450). High point pressures are avoided by supporting the patient on rows of transversely arranged microporous air sacs mounted on an integral bed frame that contains the air supply unit and heater. The sacs are arranged in sections that can be separately controlled. The sacs are waterproof but vapour permeable and air is continuously circulated through the perforations, which maintains a dry skin. Very low point pressures are achieved.¹³ Weekly routine maintenance is required and a period of training needed to use this system effectively. The equipment is bulky, rather noisy, and probably best reserved for special cases such as intensive care and burns units.

FLOTATION BEDS

True flotation produces no pressure gradients and therefore no tissue distortion. Unfortunately, only deep tank systems can provide genuine flotation, and these are disadvantaged by cost, weight, and complexity of use. Shallow water beds inevitably cause some distortion through tension in the covering material or "grounding," or both. Whether they have any advantages over more manageable static or air mattresses is doubtful. All types of water bed have potential difficulties with regulating water temperature, restricting the patient's movement, and motion sickness in susceptible people. Moreover, nursing procedures on the unstable surface (especially lifting or

FIG 4—Low air loss bed (Mediscus): used for high risk patients in special departments such as intensive care units

transferring heavy or disabled patients) are awkward and special instruction is needed.

DRY FLOTATION

Some of the disadvantages of water beds are overcome by "dry flotation" systems. Here the patient lies on a tank of glass microspheres that are converted into a "fluid" medium by blowing air through them. The flotation instantly disappears when the blower pump is turned off, the bed setting and supporting the patient. This makes moving and nursing procedures far easier than with the water bed. Also the upward draught of warm air ensures a healthy dry skin environment. Unfortunately the beds are bulky, heavy, and expensive (£57 a day hire charge). They are perhaps best reserved for special hospital departments such as intensive care units.

MECHANICAL BEDS

These reduce the duration of pressure on vulnerable sites by facilitating patient turning. The most common in general use is the net suspension bed. Other complex mechanical beds have been designed for use in special departments, such as spinal injury units where there is a need to turn patients who require absolute immobilisation. Electric turning beds are also available.

Net suspension beds consist of a slightly elastic open net mesh, wound round and suspended from two rollers. The net is lined by a blanket or sheet, which thus supports the patient by moulding to the body contours, so minimising point loading and also allowing skin ventilation. Patient turning is achieved by simply winding the net on to one roller by using an integral handle while unwinding the other. Although net beds have gained widespread use, there is little evidence for their effectiveness. They have been popular as labour saving nursing aids, but they may be less acceptable to patients who find themselves "on display" with restricted movement. They are easy to assemble and maintain, but it may be difficult to gauge the correct tension for the net: too low and the patient is unable to move, too high and the tissue deformation occurs. Net beds may offer special advantages to patients who are at risk of pressure sores and who have painful conditions exacerbated by regular manual turning regimens, such as in generalised severe arthritis.

Selecting pressure relieving systems

The large range of pressure relieving systems and the complexity of some is daunting. A comprehensive list is provided by the Disabled Living Foundation. Few reports of comparative studies are available to guide selection and disappointingly most manufacturers provide only sparse objective supportive evidence for their product(s). The minimum information should include laboratory studies of pressure relieving characteristics and clinical trial data. Manufacturers should be more active in evaluating their products.

The Vaperm mattress is a well established prevention aid and should be considered for departments where vulnerable patients are often admitted, such as geriatric and orthopaedic wards. Large cell ripple mattresses are effective but continue to suffer from poor reliability. Padding overlays are also effective and easier to use in hospital or at home. The air wave system is valuable for those patients at high risk of pressure sores and is easier to use and considerably cheaper than air support systems. Both can be hired at daily rates rather than purchased.

The incidence of pressure sores is one of the few measures that indicate quality of care and should therefore be constantly monitored by all wards and departments. Aids are important in prevention but need to be readily available, clean, and well maintained. Ensuring education of staff about what to use, how to use it, and when is also important. These aspects of countering pressures sores cross health service departments and are therefore best addressed by a broad district wide approach. Each district should have a detailed pressure sore prevention policy with a stated means of implementation, monitoring, and constant improvement. Unfortunately few health districts have awoken as yet to this simple but highly cost effective approach.

Appendix

USEFUL ADDRESSES

Society for Tissue Viability. Wessex Rehabilitation Association, Odstock Hospital, Salisbury, Wiltshire SP2 8BJ
King's Fund Pressure Sore Group. Professor B Liversley, Department of the Care of the Elderly, St Stephen's Hospital, Fulham Road, London SW10 0TH
Disabled Living Foundation. Disability Equipment Handbook, Pressure Relief (Section 1B), 380/384 Harrow Road, London W9 2HU

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