

## When are the seeds of postoperative pressure sores sown?

*Often during surgery*

Pressure sores are often thought to be slothful chronic wounds forming slowly because of poor nursing.<sup>1</sup> In fact, they are acute injuries which develop rapidly when compression of tissues causes ischaemia and necrosis during serious illness and trauma, including surgery.<sup>2</sup> Many of the situations predisposing to pressure sores are well known (though often less well acted on), but those that arise before, during, and after surgery deserve more attention than they have received. In the United States it has been suggested that up to a quarter of pressure sores that develop in hospital originate in the operating theatre.<sup>3</sup>

Protracted squeezing of tissues between weight bearing surfaces and bony prominences cannot account for the whole pathogenesis of bedsores. An endogenous factor must be invoked that is common to the diverse conditions predisposing to pressure injury—namely, old age, malnutrition, alcohol abuse, diabetes, advanced cancer, terminal illness, sepsis, and vascular and neurological disease. These are all conditions in which multiple organs tend to fail because of failure of the microcirculation. Accordingly, pressure sores should be viewed as the result of yet another organ failure—that of the peripheral circulation. The microcirculation has long been overlooked as an organ whose function can fail. When it does, normally harmless pressures damage tissues.<sup>4</sup>

The pathophysiology of peripheral circulatory failure includes impairment of capillary vasomotion and of reactive hyperaemia—the vasodilation in response to hypoxia and catabolites. Blood flow is diverted through arteriovenous shunts away from capillaries. Capillary thrombosis, tissue hypoxia, and necrosis result, even though total tissue blood flow need not be reduced.<sup>5</sup> Pressure sores are thus the pathological result of peripheral circulatory failure. But when do peripheral circulatory failure and pressure sores threaten surgical patients? In vulnerable patients the seeds of postoperative pressure sores, like those of postoperative deep vein thrombosis, are often sown in the operating theatre, and, as with venous thrombosis, prophylaxis must begin before surgery.

Indeed, particularly in emergency surgery, predisposing conditions arise before the patient even reaches the operating theatre. Lying on standard accident and emergency department trolleys generates high pressures on the sacrum and heels, and long waiting times are common.<sup>6</sup> Dehydration due to withholding of oral

fluids increases tissue deformability.<sup>2</sup> Effective analgesia is unlikely to be given at this stage (or later for that matter), and pain prevents patients from moving and increases oxygen demand<sup>7</sup>—both factors that endanger tissues.

Anaesthetists' drugs may precipitate peripheral tissue damage. Sedatives, hypnotics, and anaesthetics reduce awareness of pressure discomfort and induce immobility. They may cause hypotension and peripheral hypoperfusion.<sup>8</sup> Vasoactive amines reverse hypotension at the expense of tissue perfusion. Excess oxygen may cause overproduction of toxic free radicals in elderly patients (S Muravchick, Age Anaesthesia Association and British Geriatrics Society, London, 1998). It is surprising that no study has yet addressed the likely link between anaesthesia—spinal or general—with its hypotensive episodes and the development of pressure sores; this may be because anaesthetists are usually unaware of damages suffered by tissues in theatre (S Muravchick, Age Anaesthesia Association and British Geriatrics Society, London, 1998).

Conditions on the operating table itself may also predispose to pressure sores. The use of warming blankets under patients increases the risk of pressure damage.<sup>9</sup> Extracorporeal circulation for cardiovascular procedures has been shown to be associated with pressure sores, most of which developed intraoperatively.<sup>10</sup> Elderly patients with femoral neck fractures—another high risk group—develop them early, “chiefly in the first week,” remarked Sir James Paget in 1862.<sup>11</sup> They often appear on the day of operation.<sup>6</sup> It is not just the patient, but every part of his or her body, that must survive the operation. A full thickness peripheral tissue injury is a disaster and a justifiable cause of litigation.<sup>10</sup> Clinicians should take care to ensure adequate peripheral perfusion in pressure areas during operations on susceptible individuals. The development of effective pressure relieving supports for use in theatre is long overdue. Large celled alternating pressure mattress overlays, as used in wards, may be too unstable, but smaller celled models may be adequate and are worth testing in well designed studies.

Guidelines for postoperative management rarely recommend pressure relieving supports in high risk situations, although sores may be prevented if they are used.<sup>9</sup> Instead, emphasis is placed on “early ambulation.” However, when impossible, because of illness or debilitation, ambulation consists of sitting—“early

angulation" (VV Kakkar, personal communication). Weak patients are slumped in chairs, where it is more difficult for them to move and pressure relief is less effective than on pressure relieving mattresses.<sup>2</sup> Nursing postoperative patients in chairs causes exhaustion, reduces peripheral blood flow, and prevents sleep (which is essential for healing). Failing postural reflexes aggravate hypotension, dependent oedema forms, and renal function is depressed. Placing the feet on a footstool does not help and increases pressure on the buttocks and heels. Compression stockings do not control oedema and can themselves cause pressure sores.<sup>4</sup> In a crossover study, pressure sores were found to be less frequent in patients with fractures allowed to sit for two hours or less per session than in those in whom chair nursing was unlimited.<sup>12</sup>

Postoperative epidural analgesia, which can decrease sensation and mobility, has been associated with the development of severe sacral sores in elderly patients (IA Donovan, personal communication).

Until the prevention and management of peripheral circulatory failure, both inside and outside the operating theatre, becomes part of every doctor's training, pressure injuries will continue to torture patients and keep their carers busy when it is too late.

Mary Bliss *consultant physician*

Homerton Hospital, London E9 6SR

Bruno Simini *consultant anaesthetist*

Anaesthesia, Intensive Care, and Pain Management Unit, Ospedale, 55100 Lucca, Italy

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## The effects of weapons and the Solferino cycle

*Where disciplines meet to prevent or limit the damage caused by weapons*

When designers of weapons want to know if their creations are effective they observe the simulated effects of those weapons so they can modify and develop them and, in a cycle of activities, test them again. They then want to observe the real effects after the weapons have been produced, transferred into the hands of users, and used against their intended human target. Observing and documenting the real effects of weapons in the field, however, falls to health professionals rather than to weapons designers. The observation and documentation of the effects of weapons then forms an essential part of another cycle of activities. Instead of providing feedback about weapon design, this second cycle works in the interests of the victims of weapons by generating policies and laws that impose limits on the design, production, transfer, or use of weapons.

The original turn of this second cycle was initiated by Henry Dunant, who observed the effects of munitions on soldiers at the Battle of Solferino in 1859. Until then Europe's aristocracy had seen war as glorious. Dunant's documentation of the reality in *A Memory of Solferino* changed this perception.<sup>1</sup> In 1863 he and four other Geneva dignitaries created the International Committee of the Red Cross and drew up the First Geneva Convention, which protects sick and wounded soldiers and those caring for them from further attack.<sup>2</sup>

The past 100 years have seen many turns of the second cycle. Dum-dum bullets were prohibited in the Hague Declaration of 1899: their efficacy when used

### The Solferino cycle involves:

- Recognising* that the effects of weapons on humans are determined by the design, production, transfer, and use of weapons
- Observing and documenting* the effects of weapons and their use
- Communicating* the observations to bring about changes in behaviour, law, or policy to protect victims and potential victims from the effects of weapons

against "semi-civilised or barbarous races" equated to being excessively cruel and inappropriate for use in wars between "civilised nations."<sup>3</sup> The use of chemical weapons was prohibited by the Geneva Protocol of 1925 after observation of the horrific effects—and limited military utility—of gas in the first world war. Aerial bombardment of cities in the second world war made urgent the addition of a Fourth Geneva Convention in 1949 to protect civilian populations in war.<sup>2</sup> The destruction of Hiroshima and Nagasaki emphasised this need and provided the sad opportunity to document the effects on humans of a nuclear attack. Physicians have projected the effects of nuclear war on public health and have inevitably become effective advocates for restraint and international treaties about nuclear weapons.<sup>4,5</sup>

The most recent example of a complete turn of the second cycle is the campaign to ban antipersonnel mines. Knowledge of the effects of the design, production, transfer, and use of mines on human lives and