

Neonatal wound care: minimising trauma and pain

The increased survival rates of neonates from lower gestations (i.e. 23–4 weeks gestation upwards) have introduced complex issues of skin care and wound management in these vulnerable infants, as skin injuries and wound complications remain a source of potential morbidity. Guiding wound care practice in this area is challenging because of the ethical dilemma of conducting clinical studies within the patient population. This article is aimed at healthcare professionals involved in the care of neonates and provides practical guidance in minimising trauma and pain when managing the wounds of young babies.

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KEY WORDS

Atraumatic dressings
Neonatal skin
Wound care
Wound types

The rate of survival has increased for prematurely born neonates in recent years, and this has introduced new concerns for skin care and wound management, as trauma to the immature skin can lead to complications (McManus Kuller et al, 2002) which can be fatal. Furthermore, evidence suggests that neonates are more sensitive to pain than older children and adults (Anand, 1998; Johnson et al, 1999; Anand et al, 2001), and this can cause long-term developmental or behavioural effects (Porter et al, 1999).

Management of pain is hindered by the lack of awareness among some healthcare professionals that neonates actually feel pain (newborn infants

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may not show a vigorous behavioural response to pain), and anxiety among carers concerning the possible adverse effects of analgesia (Anand et al, 2001).

Developing evidence-based guidance for neonatal wound care practice and pain management is limited by the ethical issues involved in carrying out clinical studies on these vulnerable infants, and there is a need for national consensus on neonatal wound care. With that in mind, an independent advisory group was formed which subsequently published practical guidelines for minimising trauma and pain in caring for a variety of common wounds affecting neonates (i.e. infants from birth, regardless of gestation, to one month of age) (Independent Advisory Group, 2005). The practical guidelines are summarised here.

Increased risk factors for neonatal skin

Although epidermal development is complete by the end of the second trimester of pregnancy, the skin remains thin and poorly keratinised before 28 weeks' gestation (Wysocki, 2000). Consequently, the barrier function of the skin in premature infants is minimal and the neonates are therefore exposed to a number of risk factors (McManus Kuller et al, 2002). These include high transepidermal water loss, which can be as much as 15 times greater in pre-term children compared

with full-term, and leads to excessive heat loss from the constantly damp skin (Rutter, 1996). Furthermore, the compromised barrier means there is increased potential for chemicals to be absorbed through the skin and the infants are more susceptible to infection (Rutter, 1996).

Neonates are also vulnerable to iatrogenic tissue damage (Rutter, 2000; Wysocki, 2000; Irving, 2001a) caused by monitoring probes and care procedures. The dermis does not fully develop until after birth and, even at full-term, it is only 60% of its adult thickness (Wysocki, 2000). The fibrils connecting the epidermis and dermis are reduced in number and more widely spaced in neonatal skin, leaving it vulnerable to shearing forces; it is easily damaged or removed, especially by adhesive products (epidermal stripping) (Irving, 2001a).

At 24 weeks' gestation, the skin appears moist, shiny and red because of the lack of subcutaneous fat between the dermis and muscle tissue (Irving, 2001a). Subcutaneous fat does not begin to develop until 29 weeks' gestation. However, exposure to air accelerates maturation of the neonatal skin so that, no matter how premature the infant, within 2 weeks the skin will have developed to the same extent as that of a full-term infant (Evans and Rutter, 1986; Wysocki, 2000).



Figure 1. Photos of 2-week-old baby, born at 30 weeks gestation.

Managing specific wounds in neonates

The immaturity of neonatal skin (Figure 1) means the infant is susceptible to a number of specific types of wounds for which special treatment guidelines should be considered.

Epidermal stripping

Epidermal stripping is a particular risk for neonates born before 27 weeks' gestation (Irving, 2001a). The skin damage can easily occur, for example, when removing adhesive tapes that are used to secure tubes or dressings, as these products may bond to the epidermis more strongly than the epidermis does with the dermis (Gunderson and Kenner, 1995). All tape should be evaluated before use and the minimum amount necessary applied (Malloy-McDonald, 1995).

Clear film dressings should be used to secure intravenous (IV) cannulae as they allow monitoring of the site without removal. An alcohol-free skin barrier film applied beneath the film dressing may also help to reduce skin stripping (Irving, 2001b). In some cases, handling alone may cause epidermal stripping and it is important to ensure that nails are kept short and all stoned rings are taken off, as these can cause damage to the neonatal skin. Splints used to support IV cannulae can be secured using Velcro strapping as an alternative to adhesive tapes, but the site must always be visible.

Chemical burns

Chemical burns can be caused by contact between alcohol-based skin preparation solutions and the fragile skin of the neonate (Harpin and Rutter, 1982; Watkins and Keogh, 1992). If these agents are applied before insertion of umbilical lines, IV cannulae or drains, they should be rinsed off immediately with sterile water. However, it is better to avoid them totally and instead use aqueous-based skin preparations such as chlorhexidine (West et al, 1981). All solutions should be applied sparingly and exposure limited, as overgenerous application can result in the baby lying on alcohol-saturated bedding during the procedure, which can lead to full thickness burns due to the prolonged contact. Repeated use of iodine-based solutions can cause hypothyroidism due to iodine absorption and should be avoided in the pre-term infant (Linder et al, 1997).

Thermal injuries

Thermal injuries can be caused by heat from monitoring electrodes or, more rarely, the fibre optic 'cold light' used to identify veins or arteries for insertion of cannulae or central lines. Burns from electrodes that heat the skin (to cause dilation of blood vessels for monitoring of transcutaneous O₂ and CO₂), can be avoided by reducing the temperature

and the length of their application time, according to the age and gestation of the neonate (Gunderson and Kenner, 1995). Cold light burns may be prevented by minimising usage time of the fibre optic light, and the use of a protective guard will prevent direct contact with the skin.

Pressure/ischaeic injuries

Pressure/ischaeic injuries are relatively rare in neonates due to their body's large surface area to weight ratio. However, neonates who are sedated or paralysed and therefore unable to make spontaneous movements are at risk of pressure injuries (Gunderson and Kenner, 1995). Infants with low blood pressure and receiving inotropes are also at increased risk, as this medication causes vasoconstriction in peripheral blood vessels in an effort to improve the blood pressure. The reduction in blood flow to the peripheries can result in poor perfusion, which increases the risk of pressure damage (Lund, 1999), and this also can occur with oedematous babies.

Pressure ulcers or ischaemic injuries may occur on the ears or the occiput if the neonate is nursed supine, or on the knees if nursed prone and a programme for repositioning babies should be developed to prevent pressure ulcers or ischaemic injuries occurring. Pressure-reducing surfaces that are suitable for incubators will reduce the risk further. These include gel/viscous fluid pads, air-filled mattresses and pressure-redistributing foam mattresses (Lund, 1999). Pressure ulcers may also be avoided by making sure that infants are not lying on tubing and by using IV cannulae that do not have wings. Saturation probes should be repositioned every 3–4 hours, or more frequently for very pre-term babies (National Association for Neonatal Nurses, 1997).

If the baby is receiving nasal continuous positive airway pressure (CPAP), care must be taken to ensure that the nasal prongs fit correctly and that the pressure under the prongs is relieved on a regular basis, otherwise damage may occur to the nasal

septum (Glynn, 2004). There are no set recommendations for the frequency with which this must be done, so it should be performed on an individual basis. Babies may become oedematous post-delivery, and clothing or tapes must be loosened if this occurs, to reduce the risk of pressure ulcers developing.

Extravasation injuries

Extravasation injuries occur when vesicant fluid inadvertently leaks from a vein/cannula site into surrounding tissue. This leakage can be caused by dislodgement of the tip of the cannula or puncturing of the vein, and quick action is essential to minimise further injury. Neonates most at risk of extravasation injury include those receiving IV caffeine, glucose (>10%), calcium, or total parenteral nutrition (TPN), particularly when these are given through a peripheral line (Blatz and Paes, 1990). Infants receiving hypertonic solutions (Hecker, 1993) or IV inotropes, which cause vasoconstriction, are also at risk.

This risk can be reduced by ensuring that the cannula is carefully sited using tributaries of the cephalic and basilic veins on the dorsum of the hand, the dorsal venous arch and the medial and lateral marginal veins in the foot. Scalp veins should be used only as a last resort as shaving off the hair around the area is necessary and cannulae are difficult to secure (Blatz and Paes, 1990).

Sterile transparent film dressings should be used to secure the line, thus allowing good observation of the site. Although the median life span of an IV cannula in neonates is 36 hours (Hecker et al, 1991), the tip may become obstructed by fibrin or thrombin, especially if left in place for too long. Therefore, lines should be checked for signs of leakage, dislodgement, swelling, oedema or blanching at least hourly, so that the practitioner is able to respond quickly to any reduction in patency (Bravery, 1999).

Ischaemic injuries

Ischaemic injuries can result from extravasation of a peripheral arterial line, as stated above, but more

frequently, they will be caused by arterial spasm. Inspection of arterial lines every 30–60 minutes is recommended and once a problem has been identified, the line should be removed immediately. A loss of trace on the blood pressure transducers that are attached to peripheral arterial lines indicates that the line is not functioning properly, and any difficulty in sampling blood from the line may suggest a predisposition to arterial spasm or clot formation and the line should be removed to prevent an ischaemic injury from occurring.

Pain is a classic symptom of wound infection but as these infants cannot vocalise their pain, staff must observe for signs of extreme quietness, facial actions such as brow bulges or eyes squeezed shut, a change in heart or respiratory rate, increased oxygen requirements or intolerance of feeds.

During the antenatal period, amniotic banding injuries can occur. This rare birth condition is caused by rupture of the amniotic sac early in the pregnancy, which leaves the developing foetus exposed to the placenta's fibrous tissues. These can become entangled with the developing limbs, acting as a tourniquet as the baby grows and causing varying degrees of damage that ultimately may result in poorly perfused or ischaemic and gangrenous limbs. Immediate surgery may be required in these cases in order to save the affected limb or digit.

Surgical wounds

Surgical wounds in neonates are often closed subcutaneously (with no external sutures) or sutured and covered with a film dressing so the wound site is visible. It is important that these wounds are viewed with each set of care procedures for signs of infection (such as redness, swelling, increased exudate or presence of pus) that can prevent the wound from healing, and all assessments documented appropriately.

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Film dressings can be left in place for 7 days to reduce the potential for infection, although advice from the appropriate surgical team and/or tissue viability or medical teams should be followed, alongside manufacturers' recommendations.

Wounds caused by congenital conditions

These wounds are more likely to require special care and attention. This category includes Epidermolysis Bullosa (EB), a group of skin conditions where the common factor is a tendency for the skin to blister or shear away in response to minimal friction or trauma. These mechano-bullous disorders vary in course and severity from minor disability to death in early infancy. The prevalence of severe forms of EB in the UK is approximately 1:175,000 live births and these infants require specialised handling techniques to avoid epidermal stripping as a result of friction and shearing forces (www.debra.org.uk).

The wounds should be dressed with appropriate non-adherent material but care must be taken because many dressings described by the manufacturer as 'non-adherent' behave differently on those affected by EB.

Products that bond to the skin, such as adhesive dressings or tapes, must be avoided and cardiac and oxygen saturation monitors fixed in place with a non-adherent dressing to prevent skin injury. In particular, soft silicone dressings can be useful as a tape for patients with EB. However, if bonding does occur, the adhesive can be dissolved using a greasy emollient white soft paraffin (WSP) and liquid paraffin (LP) 50:50 mixture, applied liberally over the dressing/tape and

worked underneath, to allow the dressing/tape to be removed without damaging the skin.

Humidity and heat can increase the rate of blistering in those with EB and blisters must be immediately lanced or aspirated using a hypodermic needle. It is also recommended that clothing is turned inside out to avoid seams rubbing on the skin; alternatively, flat-seamed garments can be used.

Affected infants should be nursed in a cot rather than an incubator, unless medically indicated for reasons such as prematurity. Friction and adherence of nappies can cause excoriation in those with EB, but this can be avoided by cleaning the skin with WSP/LP 50:50 and lining the nappy with soft material, the easiest being a commercial nappy liner that overlaps the edges of the nappy. Periumbilical trauma to the skin can occur from a cord clamp in babies with EB. In order to avoid this, the clamp should be removed and replaced with a ligature.

Excoriation

Excoriation in the nappy area is generally caused by prolonged contact with urine-soaked material, which can be exacerbated by frequent diarrhoea, or fungal colonisation by the resident gut flora *Candida albicans* (Boiko, 2000). If colonisation by *C. albicans* is suspected then a skin swab should be taken and anti-fungal therapy given while waiting for swab results. Topical and enteral nystatin therapy should be prescribed and continued until there are two clear swabs. If the initial swab is negative, therapy can be discontinued immediately.

Nappies should be changed frequently (every 4–6 hours) and the skin gently cleansed with warm water only; wipes are not necessary, as they expose the preterm infant to unnecessary chemicals, but may be used in an older infant. Alkaline soaps or perfumed baby bath products should be avoided for the first few weeks of a pre-term infant's life, because the skin's protective acid mantle will not yet be developed, making it vulnerable to pH alteration by these products, leaving it more prone to bacterial colonisation.

The products also contain dyes and perfumes that may irritate the skin (NANN, 1997).

A layer of hydrocolloid or zinc paste, or nappy cream will serve as an effective barrier to protect the injured skin (BNF, 1999). However, if too thick a layer is applied then it may interfere with the absorptive properties of the nappy, leading to maceration of the skin as the urine will not be absorbed into the nappy. Skin barrier films can also be used but care must be taken regarding the potential for absorption of the product and the possible consequences due to toxicity. If the baby's condition is very unstable then handling should be reduced to a minimum and all care given at one time, depending on the policy of the neonatal unit.

Ideally, any wound dressing used on a neonate should be able to protect the wound while being atraumatic...painful stimuli can be avoided by choosing dressings that are easy to apply, do not need to be changed too frequently and promote wound healing.

Best practice at dressing changes

Choice of dressing

Ideally, any wound dressing used on a neonate should be able to protect the wound while being atraumatic, i.e. prevent trauma and pain to the wound or surrounding skin on removal. Painful stimuli can be avoided by choosing dressings that are easy to apply, do not need to be changed too frequently and promote wound healing. Where appropriate, the dressing should be cut to the correct size of the wound to prevent it coming into contact with the surrounding skin; however, in a humidified environment, there may be problems with dressings staying in place.

Non-interactive dressing products, such as soft silicone wound contact layers or hydrocolloids, hydrogels, foams and semipermeable films, are

routinely used. Dressings that create a moist wound-healing environment encourage autolytic debridement (Miller, 2000). However, if surgical debridement is required, it must be performed in a controlled environment by an appropriately qualified person; for this group of patients a surgeon usually carries out this procedure. There is limited research-based evidence to guide the selection of the most suitable products and so it is important to liaise with the tissue viability team, refer to local wound management guidelines and contact other neonatal units to ascertain their practices.

Dressing procedure

Ideally, two people should assist during dressing changes for neonates, one to contain and comfort the baby, and one to change the dressing. Dressing changes should be kept to a minimum and tapes or dressings only removed when necessary. Stress to the infant during the dressing procedure can be reduced further by minimising noise levels, and avoiding bright lighting and too much handling. No equipment should be placed on top of the incubator, even when space is limited, because of noise transmission (American Academy of Paediatrics, 1997).

The dressing should be prepared before uncovering the baby in order to minimise the length of time that the wound is exposed as well as the baby undressed or uncovered. This is for thermoregulatory reasons and to minimise stress.

If the wound requires irrigation, use warm and not cold fluids because these will reduce the temperature of the wound bed and, as a result, polymorphic and macrophagic activity will cease until the temperature increases again. Nursing staff should conform to the principles of aseptic technique during all dressing procedures to prevent cross contamination.

Pain assessment and management

The assessment of the baby's pain is based on behavioural characteristics, including crying, facial expressions,

Key Points

- ▶▶ The survival rates for neonates from lower gestation periods have increased.
- ▶▶ The immaturity of pre-term neonatal skin means neonates are more vulnerable to a number of skin and wound complications as there is compromised barrier function.
- ▶▶ Neonates are susceptible to a variety of specific injuries or wounds for which special treatments should be considered, as normal patient care may not be appropriate.
- ▶▶ The choice of dressing is important when treating immature skin and atraumatic dressings are essential.

motor responses, body posture, activity, restlessness or undue quietness (Royal College of Nursing, 2002). Although various tools have been developed to assist in this process, it is important that they are not used in isolation (Royal College of Nursing, 2002). Assessment must also include consideration of the infant's overall clinical condition, gestational age, the environment and the views of the parents (Royal College of Nursing, 2002).

Treatment of acute pain or pain with short duration can include non-pharmacological interventions such as containment, non-nutritive sucking or the use of pacifiers, along with sucrose. However, pain from skin injuries or wounds will not be relieved by these methods and pharmacological preparations may be required, such as paracetamol (Choonara, 1992) or opioids (Anand, 2001). Treatment of pain is a vast subject that is beyond the scope of this article, so it is recommended that readers should refer to local policies and guidelines.

Communication with parents

Parents may feel guilty or anxious that their baby has been born prematurely or that the baby might be in pain.

They may need reassurance that the appropriate treatment is being carried out. It is therefore important to identify their level of understanding and how much they want to know about their baby's wound. Parents should be encouraged to be involved in their baby's care if they wish. If a dressing is to be left in place for up to a week, then the rationale needs to be explained, as the parent may be accustomed to everything else being changed at least daily.

Documentation

It is important that all wound care objectives and management plans are documented, and details of the wound assessment recorded, including:

- ▶▶ The type of wound
- ▶▶ The position of the wound
- ▶▶ Wound dimensions (length, width and depth)
- ▶▶ The nature of the wound bed
- ▶▶ The condition of surrounding skin
- ▶▶ Exudate level
- ▶▶ Colour and consistency
- ▶▶ Presence of odour and infection
- ▶▶ Level of pain (Bale and Morison, 1998).

Conclusion

Skin and wound complications are a source of morbidity in neonates and the appropriate prevention and management of pain are central to the care of these vulnerable infants. Minimising trauma and pain at wound dressing changes therefore must be considered as a key component of healthcare provided to neonates. This article has combined the experience of specialist practitioners in neonatal care and in wound care to provide practical guidance on how to preserve skin integrity in neonates where possible and how to minimise trauma and pain during wound care procedures. **WUK**

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