

Pain management and sedation for children in the emergency department

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Children commonly present for emergency care with painful conditions and injuries. Further painful, distressing, or unpleasant diagnostic and therapeutic procedures may be necessary during the visit. Emergency clinicians are expected to provide safe and effective analgesia and sedation for children, and provision of such analgesia is a primary audit standard of the College of Emergency Medicine.¹ We provide an overview of published evidence to help clinicians assess, manage, and minimise pain in children presenting to hospital.

How is acute pain best assessed in children?

The assessment of pain is a core feature of most international triage systems. National guidelines suggest that children with moderate or severe pain should be triaged as urgent and should wait no longer than 20 minutes for administration of adequate analgesia.¹

Several methods of assessment have been validated for assessing the severity of pain (table 1).² The ability to indicate the presence of pain emerges at around 2 years of age. Children as young as 3 years may be able to quantify pain using simple validated pain scales,³ such as verbal rating scales, visual analogue scales, and faces scales (figure).^{4,5} A large observational study found little evidence for using abnormal physiology—such as tachycardia, tachypnoea, and hypertension—to screen for severe pain, although the presence of abnormal physiology may indicate

SOURCES AND SELECTION CRITERIA

We searched Medline, PubMed, and the Cochrane database for evidence from systematic reviews and clinical trials. We searched websites of major international royal colleges and colleges of paediatrics and emergency medicine for published guidelines. We also used our personal experience of practice. Search terms used included “pain”, “analgesia”, “sedation”, “children”, and “emergency”.

its presence. In the acute setting, behaviour is the main way that infants and preverbal children communicate their pain.⁶ Specific distress behaviours such as crying, facial grimacing, certain postures, and inability to be consoled have been associated with pain in young children. Such responses have been incorporated into pain assessment tools for preverbal children. The Children's Hospital of Eastern Ontario pain scale (CHEOPS) is considered the gold standard, although it is complex and may be difficult to use in the acute setting.⁷ The faces legs activity cry consolability (FLACC) scale provides an alternative framework for assessment.⁸

A randomised controlled trial found that parents were more likely than doctors to classify their child's pain as severe when present during a painful procedure; this suggests that it may be useful to involve parents in pain assessment.⁹ Parental comforting during the procedure did not relieve pain more effectively than when the parents did not comfort or were absent. Parental presence during a painful procedure did, however, relieve parental anxiety.

What is the role of non-pharmacological methods in paediatric pain relief?

A recent Cochrane review found sufficient evidence to support the efficacy of distraction, hypnosis, and cognitive behavioural techniques in reducing needle related pain and distress in children and adolescents.¹⁰

The national service framework for children recommends play for children in hospital.^{w3} Play specialists have a key role in providing age appropriate support. Parents and carers should be encouraged to stay with their child and offer reassurance at all times. Having a designated children's play area—with books, toys, and

SUMMARY POINTS

Ensure that children do not experience prolonged or additional pain when presenting for emergency medical care; use a composite assessment tool to assess pain at triage
Aim to provide effective analgesia at the first attempt—use the appropriate drug, dose, and route; if possible choose painless modes of delivery (nasal route, flavoured syrups)
Reassess pain scores frequently to ensure that analgesia is effective and allow enough time for it to work
Use pharmacological and non-pharmacological modalities to manage pain
Avoid the “routine” use of unnecessary painful invasive procedures
Use topical, local, and regional anaesthesia along with appropriate safe procedural sedation to avoid further pain

Table 1 | Examples of validated pain assessment tools²

Assessment tool	Age range	Assessment
Premature infant pain profile (PPP) ^{w1}	Term and preterm neonates; may be less reliable in the youngest of preterm neonates	Gestational age, behavioural state, heart rate, oxygen saturation, brow bulge, eye squeeze, nasolabial furrows
Faces, legs, activity, cry and consolability (FLACC) ⁸	Non-verbal children other than neonates; can be adapted for use in cognitive impairment	Facial expression, leg position, activity pattern, presence of crying and nature of cry, ability to be consoled
Wong Baker faces ⁴	3 years onwards	Five line drawn faces generated from children's drawings
Adolescent pediatric pain tool ^{w2}	Good for complex pain needs and chronic pain in school age children	Uses a body diagram graphic in conjunction with a word selection tool (includes instructions)
Visual analogue scales	7-8 years to adult	Horizontal or vertical lines on a continuum of increasing pain; may be illustrated by colours when used in paediatrics

QUESTIONS AND AREAS FOR FUTURE RESEARCH

- What are the long term psychological benefits of optimised pain relief for short painful emergency procedures?
- New delivery methods and agents for more immediate analgesia (such as lidocaine iontophoresis, intradermal injection systems)
- How can we implement optimal and age appropriate pain management strategies into daily practice in a busy emergency department?

a television showing children's programmes—can help to provide distraction and comfort in an unfamiliar and frightening environment.

The use of dressings, slings, and splints are other simple measures that can provide effective analgesia.¹¹ As well as the physical benefit of dressing a wound or splinting a deformed limb, covering an injury that causes the child distress to look at may provide psychological benefit. Application of cold packs is a standard approach for ligamentous sprains, and pain from insect and marine stings can be treated by applying cold or heat to the affected part. Cold spray and ice packs provide immediate relief, whereas warm water immersion provides longer lasting analgesia.¹²

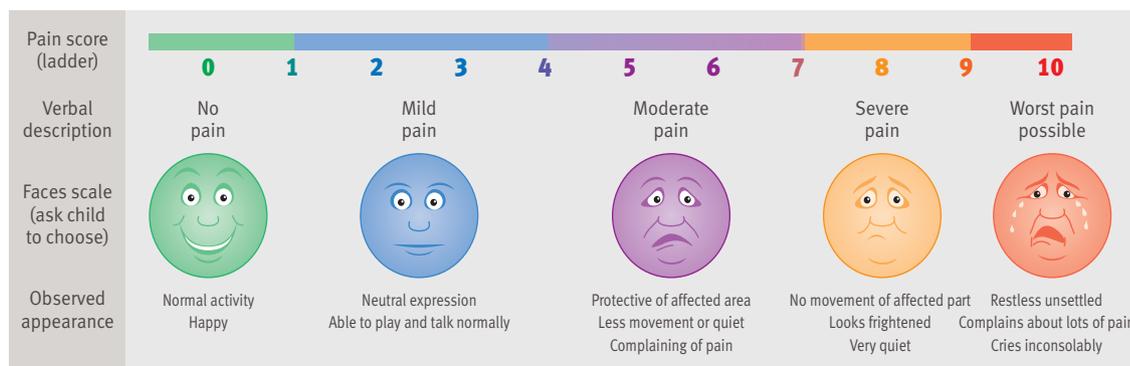
What is the best initial choice of analgesic drug?

Modern emergency practice aims to provide effective analgesia at the first attempt, on the basis of an accurate assessment of the child's pain.¹

Children with all levels of pain will benefit from administration of paracetamol (acetaminophen). A loading dose of 30 mg/kg should be given initially, followed by the maintenance dose as required (10-15 mg/kg every four to six hours; maximum 90 mg/kg in 24 hours; reduce in infants and neonates).^{w4} For severe pain, national guidelines recommend immediate administration of intravenous opiates in combination with oral drugs and the non-pharmacological methods outlined above.¹ The use of inhaled or intranasal analgesics can be valuable before intravenous access has been secured. Well designed randomised controlled trials found that intranasal diamorphine and fentanyl are absorbed rapidly across the nasal mucosa and provide initial pain relief comparable to intravenous opiates.^{13 14} Oral drugs have a delayed onset of action and their absorption is more variable than parenteral ones, but they can be given painlessly, have a synergistic effect when used with other analgesics, and are usually more acceptable to parents and children. Oral medication alone is reserved for children with mild to moderate pain.⁴ Some analgesics are available as a suppository, but administration by this route may prove unacceptable for parents and may add to the child's distress. Intramuscular administration of pain relief has a limited role in the emergency management of pain in children because the injection is often painful, absorption unpredictable, and the onset of effect slow.

How can procedures be carried out without causing further pain?

For a child with a painful condition or injury, further diagnostic or therapeutic procedures may be necessary but can cause additional pain and distress. Simple measures, such as giving a nitrous oxide and oxygen mix (Entonox) to older children or non-nutritive sucking in young infants, can make minor procedures less distressing.^{15 16} A randomised double blind placebo controlled clinical trial found single dose oral sucrose to be safe and effective in reducing the behavioural and physiological pain response to a painful stimulus in preterm infants.^{w5 w6} For each additional procedure—from needle related to radiological—carefully consider whether the procedure is immediately necessary, and



Composite pain assessment tool for children in the emergency department incorporating self reporting; faces and observational scores. Reproduced, with permission, from Elsevier⁵

A PARENT'S PERSPECTIVE

Lucy, my 8 year old daughter, fell off a trampoline and badly injured her right arm. On arrival at the emergency department, she was screaming in agony with any small movement. The triage nurse recognised her severe pain immediately. A sling was applied and she was brought straight into a cubicle in the paediatric area where a paediatric nurse encouraged me to help Lucy use the gas and air (Entonox). She was then given a strong painkiller (diamorphine) intranasally, without the need for needles. Her pain improved quickly. The nurse then placed some gel (Ametop) on the back of her other hand and after a while a doctor was able to put in a needle (an intravenous cannula) while a play specialist distracted Lucy with a puzzle book. The nurse covered up the needle with a bandage with cartoon pictures on it. After her x ray, the consultant explained that Lucy's arm was broken and needed to be manipulated. He offered us the option of having her sedated there and then. Lucy was moved to another room in the children's area and was attached to a monitor. She was given a sedative (ketamine) and she did not feel a thing while they straightened her arm and put it in plaster. Before we went home, the doctor made sure that Lucy had recovered from the sedation and that we had a supply of painkillers to take home.

if the available analgesia or psychological techniques (or both) are likely to be sufficient for the child.

For many common minor procedures, less painful alternative techniques are available, which can be combined with the pharmacological and non-pharmacological methods outlined above. For closure of small simple wounds, evidence from randomised controlled trials show that non-invasive alternatives can be as effective as traditional painful procedures. Skin lacerations can be closed with tissue adhesive rather than sutures with similar medium and long term cosmetic results¹⁷; similarly, scalp lacerations can be closed using the hair apposition technique, where strands of hair are twisted across the wound and glued together to close the wound.^{w7} When necessary, using absorbable sutures prevents the need for

future removal.^{w8} Comparative clinical studies have shown venous blood gases to be as accurate as the more painful arterial gases for monitoring acid-base status in children with uraemic acidosis and diabetic ketoacidosis.^{w9 w10}

Which topical anaesthetics are available for cannulation and venepuncture?

Topical anaesthetic preparations such as EMLA (euteric mixture of local anaesthetics—lidocaine and prilocaine) and Ametop (tetracaine) can be used on intact skin in patients older than one month before minor skin procedures. A recent Cochrane review found that Ametop is superior to EMLA for reducing overall needle insertion pain in children.¹⁸ Ametop takes 45 minutes to anaesthetise the skin, whereas

TIPS FOR NON-SPECIALISTS

Key non-pharmacological interventions

Ensure assessment and treatment in a quiet, calm, child oriented environment; a friendly non-intimidating manner in the approach of staff; and reassurance and explanation to both child and parents

Gentle immobilisation and careful dressings alleviate pressure and movement from the site of pain

Topical anaesthesia

Tetracaine (Ametop) gel can be used from age one month. It acts faster than EMLA. LAT gel (lidocaine, adrenaline, and tetracaine; contains a vasoconstrictor) should be used for open wounds

Intranasal opiates

Some opiate preparations can be given intranasally. This provides rapid bioavailability for faster analgesic effect without requiring a needle or cannula^{11 12}

Examples include diamorphine 0.1 mg/kg nasal aerosol (<0.2 ml) and fentanyl 1-2 µg/kg nasal aerosol

Sedation

Do not sedate a child unless you are appropriately trained and certified. Do consider the potential benefits of sedation, however, and seek expert help when needed

Avoiding pain

Consider whether the proposed procedure is necessary; does a less painful option exist? Use steristrips or tissue adhesive rather than sutures, and venous rather than arterial blood gases

Would general anaesthesia be preferable? Some complex or prolonged procedures are better performed on an emergency anaesthetic list rather than in the emergency department or clinic

ADDITIONAL EDUCATIONAL RESOURCES

Resources for healthcare professionals

American Academy of Pediatrics. The assessment and management of acute pain in infants, children, and adolescents. *Pediatrics* 2001;108:793-7

American Academy of Pediatrics. Committee on Fetus and Newborn. Committee on Drugs. Section on Anesthesiology. Section on Surgery. Canadian Paediatric Society. Fetus and Newborn Committee. Prevention and management of pain and stress in the neonate. *Pediatrics* 2000;105:454-61

American College of Emergency Physicians. Clinical policy: critical issues in the sedation of pediatric patients in the emergency department. *Ann Emerg Med* 2008;51:378-99.

Agency for Health Care Policy and Research. Acute pain management in infants, children, and adolescents: operative and medical procedures. *Clinical practice guideline—quick reference guide for clinicians*. 1992;1B:1-22

Royal College of Nursing. *The recognition and assessment of acute pain in children*. 2009. www.rcn.org.uk/development/practice/pain

Royal College of Paediatrics and Child Health. *Recognition and assessment of acute pain in children*. 2001

Royal College of Paediatrics and Child Health. *Evidence-based guidelines for the safe sedation of children undergoing diagnostic and therapeutic procedures*. 2002

Resources for patients and carers

Paediatric Pain Profile (www.pppprofile.org.uk/)—Behaviour rating scale for assessing pain in children with severe physical and learning impairments

Paediatric Pain (<http://pediatric-pain.ca/>)—Good resource for professionals, children, and parents or carers, with many links to other sites

EMLA takes 60 minutes, and this fact has to be incorporated into the emergency department triage assessment for children deemed likely to need blood tests or venous access. Ethyl chloride (coolant) spray is an alternative for minor cutaneous procedures such as venepuncture, especially when urgent, but its efficacy is unclear.^{19,20}

What are the topical, local, or regional anaesthesia options for wounds and injuries?

LAT gel (lidocaine, adrenaline, and tetracaine) is useful in providing anaesthesia for the cleaning and repair of open wounds such as skin lacerations. All simple lacerations of the head, neck, limbs, or trunk of less than 5 cm in length can be considered for exploration and repair using LAT gel rather than local anaesthetic infiltration. Several randomised controlled trials have shown that it has a similar efficacy but is less painful to apply.²¹

Commonly used local anaesthetics for infiltration in the emergency department include lidocaine (with or without adrenaline) and bupivacaine. Local nerve blocks (without adrenaline) completely or partially anaesthetise the area supplied by that nerve. Common examples include digital nerve blocks for injuries to the fingers, and the femoral nerve block for femoral shaft fractures. Specific nerve blocks can be performed for minor surgical procedures around the hand, face, and ears. Additional analgesia, proce-

dural sedation, or non-pharmacological techniques can make these procedures more tolerable to the child.

Does procedural sedation have a role in painful emergency procedures in children?

Background and national guidelines

Many procedures performed on children in the emergency department would cause considerable pain and distress without the use of sedation. Common examples include manipulation of a displaced long bone fracture and suturing of complex wounds where the child will not tolerate injection of local anaesthetic or remain still enough for the procedure to be performed effectively and safely. Procedural sedation allows the patient to tolerate unpleasant procedures while independently maintaining airway control, oxygenation, and circulation. Expertise in procedural sedation and analgesia is a core competency for emergency doctors and anaesthetists. In our experience, the key to safe and successful sedation is optimal pain management in the first instance. Sedation is not a replacement for effective pain management. Guidelines and policies approved by the College of Emergency Medicine and the Scottish Intercollegiate Guidelines Network, and a report commissioned by the UK Academy of Medical Royal Colleges and Faculties, support the use of procedural sedation as a safe and appropriate means to facilitate pain and anxiety management during

Table 2 | Doses and indications for commonly used analgesics and sedatives in children

Drug	Primary use (maximum daily dose)	Dose*	Example indication
Paracetamol	Analgesic (1-3 months: 60 mg/kg; 3 months to 12 years: 90 mg/kg; >12 years: 4 g)	Oral. >32/40 gestational age only: 30 mg/kg loading dose then 10-15 mg/kg every 6-8 h as needed Rectal. >32/40 gestational age only: 30-40 mg/kg loading dose then 20 mg/kg every 6-8 h as needed Intravenous. <10 kg: 7.5 mg/kg every 6-8 h; 10-50 kg: 15 mg/kg every 6-8 h; >50 kg: 1 g every 6-8 h	Used alone in mild pain (for example, a sprained ankle) or as an adjunct in moderate or severe pain
Ibuprofen	Analgesic (30 mg/kg to a maximum of 2.4 g)	Oral. <6 months: 5 mg/kg every 6-8 h, >6 months: 7.5 mg/kg every 6-8 h	Used alone in mild pain (for example, minor head injury) or as an adjunct in moderate or severe pain
Diclofenac sodium	Analgesic (150 mg)	Oral. >1 year: 0.3-1 mg/kg (maximum 50 mg) every 8 h Rectal. >6 years: 0.3-1 mg/kg (maximum 50 mg) every 8 h	Used alone in mild pain (for example, small superficial burn or scald) or as an adjunct in moderate or severe pain
Codeine phosphate	Analgesic (240 mg)	Oral. Neonate to 12 years: 0.5-1 mg/kg every 4-6 h; >12 years: 30-60 mg every 4-6 h	Used in combination with other analgesics in moderate pain (for example, buckle fracture of radius)
Tramadol	Analgesic (400 mg)	Oral (>12 years only): 50-100 mg every 6 h	Used in combination with other analgesics in moderate pain (for example, larger burns and scalds)
Diamorphine	Analgesic (10 mg maximum in a single dose)	Intranasal (>10 kg only): 0.1 mg/kg made up into a 0.2 ml solution	Acute pain in the emergency setting, for short painful procedures (for example, immediate analgesia for deformed fracture to allow splint application and cannulation of a vein)
Morphine	Analgesic	Intravenous. Neonate: 50 µg/kg every 6 hours; 1-6 months: 100 µg/kg every 3 hours; 6 months to 12 years: 100 µg/kg every 4 hours; >12 years: 2.5 mg every 4 hours	Most reliable method to relieve severe pain is by titrated intravenous opiates. Can be used in conjunction with other analgesics (for example, large burns, fractures requiring manipulation)
Midazolam	Sedative	Intravenous. 1 month to 6 years: initially 25-50 µg/kg, increased if necessary in small steps (maximum 6 mg); 6-12 years: initially 25-50 µg/kg, increased if necessary in small steps (maximum 10 mg); 12-18 years: initially 25-50 µg/kg, increased if necessary in small steps (maximum 7.5 mg) Buccal. 6 months to 10 years: 200-300 µg/kg (maximum 5 mg); 10-18 years: 6-7 mg (maximum 8 mg in those >70 kg)	Procedural sedation by appropriately trained staff with necessary equipment and monitoring facilities (for example, suturing of complex wounds that require cooperation and infiltration of local anaesthetic)
Ketamine	Analgesic and sedative	Intravenous. Up to 12 years: 1-2 mg/kg produces 5-10 minutes of surgical anaesthesia, adjusted according to response; >12 years: 1-4.5 mg/kg (usually 2 mg/kg) produces 5-10 minutes of surgical anaesthesia, adjusted according to response	Procedural sedation by appropriately trained staff with necessary equipment and monitoring facilities (for example, manipulation of angulated forearm fractures)

*See *BNF for Children* for preparations, adverse effects, and contraindications.^{w12}

interventional or diagnostic procedures, including emergencies, for all age groups.^{22 23 w11}

Drug options

Substantial evidence supports the use of a variety of agents for procedural sedation by trained emergency doctors in the emergency department (table 2).^{w12} In particular, ketamine with its combined sedative and analgesic action has been extensively reviewed. A meta-analysis of more than 8000 cases found the use of ketamine as sole sedative agent to be safe in children aged 2-13 years (1-2 mg/kg racemic ketamine intravenously). Short term side effects include “bad dreams,” vomiting, and ataxia. Risk factors for airway and respiratory adverse events were high intravenous doses and coadministration of anticholinergics or benzodiazepines.²⁴ In older children and adults, it is used as an analgesic (0.25–0.5 mg/kg intravenously) to facilitate brief painful interventions and in conjunction with other anaesthetic agents for sedation.^{w13} Other drugs commonly used for sedation in children include propofol and combined benzodiazepines and opiates (midazolam and fentanyl).²² Guidelines recommend fasting for three hours before sedation²³; however, a prospective observational study has suggested that prolonged pre-sedation fasting is not essential with ketamine.²⁵

Training and accreditation in procedural sedation in children

The UK Academy of Medical Royal Colleges and Faculties report on safe sedation practice recommends that instruction in procedural sedation be incorporated into training and revalidation programmes, and that a clinical governance framework should deliver local safe sedation procedures in line with guidelines agreed by the relevant national professional body. The box shows typical components of a local guideline. In particular, multidisciplinary team training is recommended to ensure that all staff involved in procedural sedation understand their roles and that staff who administer the sedative are aware of the possible

Essential resources and considerations for paediatric procedural sedation in the emergency department

- Appropriately trained personnel present:
- Doctor performing sedation (who has received appropriate training and has documented evidence of successful assessment of competency)
 - Doctor or practitioner performing procedure
 - Children’s nurse (who is familiar with sedation procedure, monitoring, and equipment)
- Appropriate indication—painful procedure needed during this attendance at the emergency department
- Would a general anaesthetic be more appropriate (no immediate need for the procedure)?
- Quiet location, monitoring, and equipment available (standards of monitoring set by Royal College of Anaesthetists and the UK Academy of Medical Royal Colleges and Faculties)
- Any contraindications in anaesthetic history or examination?
- ASA (American Society of Anesthesiologists) class 3, 4, or 5
 - Recent last meal (<4 hours) or recent fluid intake (<2 hours)—relative contraindication
 - Previous adverse reactions to drugs
 - Previously known anaesthetic risk (such as difficult airway)
- Explanation and informed consent from parents or legally responsible adult
- Record of drugs used including dosage and timing
- Record of vital signs before, during, and after sedation
- Record of adverse events and interventions
- Record of safe recovery

adverse consequences and have the necessary skills to manage such adverse events.

Conclusions

Safe and effective management of pain and anxiety in children is an essential component of modern emergency practice. Pain can be assessed and treated by a

Table 3 | Examples of commonly required procedures and options to reduce pain and distress in children

Procedure or injury	Distraction or CBT	Splint or dressing	Topical anaesthesia	Sucking (sucrose or pacifier)	Opioids	Local anaesthesia	Regional anaesthesia	Sedation	General anaesthesia
Venepuncture or cannulation	Yes		Yes	Yes					
Arterial puncture	Yes		Yes	Yes		Yes			
Central venous catheter insertion			Yes	Yes		Yes		Yes	Yes
Suturing	Yes		Yes	Yes		Yes	Yes	Yes	Yes
Dressing change	Yes			Yes	Yes			Yes	
Removal of foreign body	Yes		Yes	Yes		Yes	Yes	Yes	Yes
Joint reduction	Yes	Yes			Yes		Yes	Yes	Yes
Fracture manipulation	Yes	Yes			Yes	Yes	Yes	Yes	Yes
Abdominal pain	Yes				Yes				
Burns	Yes	Yes		Yes	Yes				Yes
Lumbar puncture	Yes		Yes	Yes		Yes		Yes	Yes
Chest drain insertion			Yes		Yes	Yes		Yes	Yes

CBT=cognitive behavioural therapy.

variety of pharmacological and non-pharmacological means (table 3). Children who present in pain can be assessed quickly, treated, and frequently reassessed using an evidence based model of care to ensure that the analgesic strategy is effective (table 1). Several psychological techniques can be used to put the child at ease and lessen the perception of pain. Newer methods of drug delivery will help with the administration of analgesia, and the role of safe procedural sedation in the paediatric emergency department will be consolidated.

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Improperly dressed

The authorities at Lord's, the home of cricket, have announced that spectators may wear fancy dress at certain matches. In what now feels like another age, I was at the ground with my young daughter, watching a much interrupted and largely pointless match on a rain soaked afternoon. A doctor was demanded over the public address system. Reasoning that numerous far more distinguished members of the profession were holed up in the members' enclosure, I kept quiet. The request came again and then a third time.

"Go on, dad," said my daughter.

"Go on, dad," the crowd around us took up the chant, and I had no choice.

An official met me: one of the players needed attention in the changing room. "There's just one problem," said the flunkey, "you're improperly dressed." I was not wearing a tie. "I will have to get a member of the committee," he said.

A florid faced man of military bearing was summoned. He peered disdainfully over my head

from the steps of the Pavilion: "I suppose if the bugger says he's a doctor we'd better let him in."

The dent in my pride was suppressed by my desire to see inside the holy of holies. Out of my depth, as a mere paediatrician, I diagnosed a groin strain—at the time the only athletic injury I had heard of—and ordered rest.

The injured bowler said that would need his captain's permission. He was unimpressed: "Groin strain? More like malingering. If you think he can't play, send him to hospital." I enjoyed writing my referral letter to A&E on notepaper headed with Old Father Time removing bails from a set of stumps.

I never found out the outcome and still don't wear a tie to watch cricket, but I can't help wondering whether nowadays they would let me back in even if I were dressed as a penguin.

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