Current interventions and approaches to postoperative pain management

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**Abstract**

Some degree of pain accompanies all surgical procedures. Current evidence informs us that patients will experience significant physiological and psychological effects if this pain is not adequately treated. These effects can cause serious harm, delay recovery from surgery, and in some cases lead to persistent post-surgical chronic pain. This article briefly discusses the importance of assessing patients preoperatively and highlights how some patients will have risk factors which may lead them to experience severe postoperative pain. Approaches to postoperative pain control are focused on ways to address the inter-patient differences in response to pain and treatments and avoid periods of ineffective pain relief. A review of the commonly used analgesics, paracetamol, non-steroidal anti-inflammatory drugs, opioids and local anaesthetics, and methods of administration, is included. The final section provides a short review of emerging trends in acute pain therapy and the implications for improving patient care.

**Key words:** Acute pain • Analgesia • Postoperative pain • Preoperative assessment

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This year the NHS celebrates its 60th birthday and no doubt those who have worked in the NHS for some years will have seen numerous changes in health care. Over the past 15-20 years, healthcare professionals working in pain management have witnessed a radical difference in the management of pain, particularly acute postoperative pain. Fortunately, there is a range of techniques for a variety of surgical procedures which aim to minimize pain. Additionally, healthcare professionals have access to various evidence bases which inform them of the techniques’ effectiveness. However, in spite of these facts, under-treatment of postoperative pain continues to be a major problem both in the United Kingdom (UK) and internationally (Wu et al, 2002; Ekstein et al, 2006).

The reasons for this are complex and not quickly remedied as many barriers involving the patient, healthcare professional, the organization, and in some cases, existing Government policies, thus preventing optimum pain management (Box 1) (Carr, 2007).

Healthcare professionals working in the perioperative environment are well aware that pain accompanies or follows virtually every surgical procedure. The challenge is to prevent and reduce pain where possible. To do this effectively may require approaches which are aimed at changing the organizational culture that allows uncontrolled pain to persist. This culture may be based on the outdated notion that experiencing pain is harmless and that pain medication is more dangerous than untreated pain. In the United States (US), lawsuits against hospitals for the undertreatment of pain are no longer a rare occurrence (Pasero et al, 2007). In response to this, national standards have been developed to help provide a framework for good quality pain management (Joint Commission on Accreditation of Healthcare Organizations [JCAHO], 2001). The UK is yet to follow.

This article discusses how perioperative pain is managed in the 21st century. Initially it looks at the significance of preoperative assessment and the importance of identifying patients with risk factors for experiencing severe postoperative pain and developing persistent pain. A brief review of the techniques commonly used to control pain in the perioperative and postoperative period, and the available supporting evidence for their effectiveness, follows. Innovative researchers continue to explore new and better ways of delivering pain relief; these new technologies are discussed in the final section. By knowing what is available now, and in the future, can help ensure that patients benefit from the latest pain-relief products.

**Preoperative assessment**

Acute postoperative pain differs from chronic or cancer pain because it is more transitory, and any affective component relates to anxiety about the outcome of the surgical condition and fear of pain. Indeed, many patients have poor expectations about pain relief (Wickstrom et al, 2005).

Assessment of patients preoperatively by nursing and medical staff is an important part of the surgical experience to ensure that appropriate interventions are used and recovery from surgery is as quick as possible. Time spent preparing patients psychologically for surgery has been shown to shorten hospital stay and reduce the need for postoperative analgesia (Carr and Goudas, 1999). In addition to psychological factors, anxiety is associated with physiological effects which can influence the level of pain experienced (Vaughn et al, 2007). Research has also shown that anxiety lowers immunity and can delay wound healing (Kiecolt-Glaser et al, 1995).

There is an increasing body of evidence linking acute postoperative pain and the development of persistent (chronic) pain (Kehlet et al, 2006). Acute pain generally subsides within days to weeks, but in some instances pain following routine surgical procedures exists for longer periods than expected, and in some cases interferes in return to work and leisure activities (Table 1).

**Acute to chronic pain**

The work of Henrik Kehlet and colleagues (2006) has provided evidence asserting that this persistent postsurgical chronic pain is the consequence of either ongoing inflammation or more commonly as a manifestation of neuropathic pain, resulting from surgical injury...
Box 1. Possible barriers to effective pain relief

- A belief that pain is not harmful, or that it is a 'normal consequence of surgery and injury
- Concerns that pain relief will obscure a surgical diagnosis or mask the signs of surgical complications
- A tendency to underestimate a patient’s pain and not recognize the variability in patients’ perceptions of pain
- Lack of regular and frequent assessment of pain and any pain-relieving measures
- Fears that the patient will become addicted to opioids
- Concerns about a high risk of respiratory depression with opioids
- Inadequate patient education
- Patient reluctance to request analgesia
- Lack of understanding of the enormous interpatient variability in opioid requirements
- Lack of recognition that age is a better predictor of opioid requirement than weight in the adult patient
- Prolonged dosing intervals and a belief that opioids must not be given more often than every 4 hours
- Insufficient flexibility in dosing schedules (dose and dose intervals)
- Lack of understanding of the need to titrate analgesics to meet the needs of each patient
- Lack of accountability for pain management

From: Macintyre and Schug (2007)

Table 1. Incidence of chronic pain after surgery

<table>
<thead>
<tr>
<th>Type of operation</th>
<th>Incidence of chronic pain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amputation</td>
<td>30-85</td>
</tr>
<tr>
<td>Thoracotomy</td>
<td>5-67</td>
</tr>
<tr>
<td>Coronary artery bypass surgery</td>
<td>30-50</td>
</tr>
<tr>
<td>Mastectomy</td>
<td>11-57</td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>3-56</td>
</tr>
<tr>
<td>Inguinal hernia repair</td>
<td>0-63</td>
</tr>
<tr>
<td>Vasectomy</td>
<td>0-37</td>
</tr>
<tr>
<td>Dental surgery</td>
<td>0-13</td>
</tr>
</tbody>
</table>

From: Macintyre and Schug (2007)

Problems associated with pain

Perioperatively, uncontrolled pain may harm patients by impairing cardiac, pulmonary, and endocrine functioning (Table 2). A growing body of research supports the link between serious postoperative complications (e.g. deep vein thrombosis, infections, sepsis, paralytic ileus, and acute renal failure) and uncontrolled pain (Australian and New Zealand College of Anaesthetists and Faculty of Pain Medicine [ANZCA], 2005). In addition, pain interferes with sleep, impairs immune functioning and lowers the quality of life for the patient (Arnest, 2002).

Physiological changes that result from pain and injury are a result of activation of both the peripheral and the central nervous systems. Surgical injury induces a complex 'stress response' characterized by hormonal changes and an inflammatory response leading to malaise, hyperthermia and immunosuppression. Effective analgesia is capable of modifying many of the pathophysiological responses preventing or reducing complications and assisting recovery. Various anaesthetic techniques are available to reduce the surgical stress response, such as the use of infiltration anaesthesia, peripheral nerve blocks and spinal or epidural anaesthesia. While these techniques (using local anaesthetic agents) will reduce endocrine-metabolic responses, they will not affect the inflammatory response; non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol are required here. Therefore, a multimodal approach - a combination of two or more analgesic modalities with differing analgesic mechanisms - is considered to be best practice to enhance analgesia and reduce side-effects (Myles and Power, 2007).

Preoperative prevention of pain

In laboratory studies, administration of an analgesic prior to an acute pain stimulus minimizes changes in the dorsal horn compared to analgesics given after the pain stimulus has occurred (Woolf, 1983). This has led to the controversial hypothesis (Wall, 1988) that pain relief prior to surgery may enhance postoperative pain management. However, there is still some debate over this theory, and a systematic review by Moiniche et al (2002) concluded that the timing of analgesia did not affect postoperative pain control, whatever the type of preemptive analgesia. Despite continued debates about its use, the underlying theoretical concept behind preemptive analgesia is straightforward - analgesia is given before noxious stimuli arises, accompanied by multimodal analgesia in the perioperative and postoperative period (Polomano et al, 2008). The concept of preemptive analgesia needs further research.

Preventive analgesia

Recent studies involving use of the N-methyl-D-aspartic acid (NMDA) antagonist's gabapentin and ketamine in the perioperative period to produce 'preventive' analgesic effects have shown promise. A systematic review by Ho et al (2006) on the analgesic effects of perioperative gabapentin concludes that it is effective in reducing postoperative pain scores, opioid requirements and opioid-related side-effects in the first 24 hours after surgery. At this point there is insufficient data to determine if perioperative gabapentin or pregabalin have any effect on surgically-induced chronic pain (Polomano et al, 2008). Perioperative ketamine has also been shown to have preventive analgesic effects and in some cases may reduce the incidence of chronic postsurgical or post-traumatic pain.
Table 2. Adverse effects of under-treated severe pain

<table>
<thead>
<tr>
<th>Type of pain</th>
<th>Adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Tachycardia, hypertension, increased peripheral vascular resistance, increased myocardial oxygen consumption, myocardial ischaemia, altered regional blood flow, deep-vein thrombosis, pulmonary embolism</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Reduced lung volumes, atelectasis, decreased cough, sputum retention, infection, hypoxaemia</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>Decreased gastric and bowel motility, increased risk of bacterial transgression of bowel wall</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>Urinary retention</td>
</tr>
<tr>
<td>Neuroendocrine/metabolic</td>
<td>Increased catabolic hormones: glucagons, growth hormone, vasopressin, aldosterone, rennin and angiotensin. Reduced anabolic hormones: insulin, testosterone. This catabolic state leads to hyperglycaemia, increased protein breakdown, negative nitrogen balance leading to impaired wound healing</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>Muscle spasm, immobility (increasing risk of deep vein thrombosis), muscle wasting leading to prolonged recovery of function</td>
</tr>
<tr>
<td>Psychological</td>
<td>Anxiety, fear, helplessness, sleep deprivation, leading to increased pain</td>
</tr>
<tr>
<td>Central nervous</td>
<td>Chronic (persistent) pain due to central sensitization</td>
</tr>
</tbody>
</table>

From: Macintyre and Schug (2007)

(e.g. phantom limb) (Hocking et al, 2007). Further studies are required before it is possible to recommend a specific dose or regimen for administration.

Intraoperative treatments for pain

Pain management in the perioperative period is dependent on a number of factors, including the type of surgery to be performed and the individual patient. Generally, opioids are widely used with the majority of surgical procedures either as intermittent boluses, in patient-controlled analgesia (PCA) pumps, or added to local anaesthetics in spinals or epidurals. The following section discusses these interventions and highlights the evidence of their effectiveness in postoperative pain management.

Opioids

Opioids, also known as opiates and narcotics, remain the mainstay of systemic analgesia for moderate to severe acute pain (ANZCA, 2005). There are a variety of drugs used in anaesthesia, with fentanyl, alfentanil, morphine, oxycodone and diamorphine being the most commonly ones used. Opioids act as agonists through mu, kappa and delta receptors located on cells throughout the peripheral and central pain pathways and on cells in the gastrointestinal tract (McLoughlin, 2004). They are involved in inhibition of nociception – or sensing of pain – in the dorsal root ganglia of the spinal cord, and activation of descending pain pathways from the forebrain and midbrain – therefore, modulating pain. Opioids are more effective for continuous and dull pain rather than sharp intermittent pain (Krenzischek et al, 2008).

It is worth noting that patients vary widely in response to opioids, and doses need to be titrated to suit each patient’s response; adults’ age rather than weight is a better predictor of opioid requirements (Macintyre and Jarvis, 1996). Titration for severe acute pain is best achieved using intermittent intravenous (IV) bolus doses as it allows more rapid titration of effect and avoids the uncertainty of absorption. The use of an algorithm based on age and pain score given at 3–5-minute intervals as needed is useful in establishing rapid analgesia and minimizing adverse effects (Macintyre and Schug, 2007). Common adverse effects, including sedation, itching, nausea, vomiting, slowing of gastrointestinal function and urinary retention, are dose-related, i.e. once a threshold dose is reached; small increases in the opioids are associated with increases in adverse effects (Zhao et al, 2004).

Patient-controlled analgesia (PCA)

For over three decades patients have been safely using PCA, and they are routinely used for many surgical procedures. There are clear benefits as patient satisfaction is improved and to some degree nursing time decreased (Kehlet and Holte, 2001). In addition, PCA provides better analgesia than conventional intramuscular or subcutaneous opioid regimens, and there is also some evidence of a decreased risk of postoperative pulmonary complications (Walder et al, 2001). There is limited data available on what the optimal sized bolus should be. In patients prescribed morphine 0.5 mg, 1 mg and 2 mg bolus doses, most of those prescribed 0.5 mg were unable to achieve adequate analgesia, while a high incidence of respiratory depression was reported in those who received 2 mg (ANZCA, 2005). The optimal dose was therefore 1 mg. Although rigid adherence to this optimal dose may not lead to best pain relief for all patients, factors to take into account include history of prior opioid use and the patient’s age.

Background infusions and dose limits can be programmed into PCAs; however, current evidence suggests that there are no benefits to pain relief, sleep or reduction in demands (Dal et al, 2003). Audits of adult patients have shown that the risk of respiratory depression is increased when background infusion is added, therefore, routine use is not recommended, although may be useful in opioid-tolerant patients (Schug and Torrie, 1993; Sidebotham et al, 1997; ANZCA, 2005). One of the most important and often overlooked determinants of successful PCA is that the patient should be reasonably comfortable when it is begun; therefore, pre-loading with opioids is necessary (Pasero et al, 2007).

Paracetamol

The exact mode of action of paracetamol remains to be confirmed. However, it is thought to act by selectively inhibiting the release of prostaglandins within the central nervous system as well as having some peripheral analgesic effect (Nikles et al, 2005).

Paracetamol is widely used for pain relief and for its antipyretic effects, although it only has a weak anti-inflammatory effect, and has few significant side-effects if taken at correct doses. Paracetamol is used as a basic building block of most postoperative
analgesic regimens. It is well accepted that adding paracetamol will result in a reduction of postoperative opioid requirement and therefore a reduction in side-effects associated with opioids. Oral paracetamol is absorbed well from the small intestine; it can also be given rectally, and more recently an IV with opioids. Oral paracetamol is absorbed postoperatively (Myles and Power, 2007).

NSAIDS and cyclooxygenase-2 (COX-2) inhibitors
NSAIDs and COX-2 inhibitors are useful analgesic adjuncts that can improve pain relief while reducing opioid requirements postoperatively (Myles and Power, 2007). They have a combination of analgesic, anti-inflammatory and antipyretic effects. Their principle therapeutic actions primarily inhibit the synthesis of prostaglandins, specifically the action of cyclooxygenase (COX) – the initial enzyme in the pathway of prostaglandin synthesis. Prostaglandins sensitize nociceptors to mechanical and chemical stimuli by lowering the threshold of the nociceptor. In addition, NSAIDs exert their action on the dorsal horn cells of the spinal cord to decrease reactive hyperalgesia that may occur in response to peripheral inflammation (Krenzischek et al, 2008).

Prostaglandins are known to be involved in numerous physiological functions, including gastric mucosal protection, renal tubular function and intrarenal vasodilation, bronchodilatation and platelet formation (Table 3). Consequently, the potential side-effects – bleeding and renal failure – restricts their use intraoperatively in high-risk patients (those with pre-existing gastric ulceration and renal dysfunction) and certain surgical procedures (tonsillectomy, cosmetic surgery, eye surgery, and following heparin during cardiovascular procedures) (Kehlet and Dahl, 2003). It is worth noting that NSAID side-effects are more common with long-term use than short-term postoperative use.

**COX-2 inhibitors**
Evidence suggests that conventional NSAIDs could be replaced by COX-2 inhibitors (which selectively target the cyclooxygenase-2 enzyme) in some situations where short-term treatment is indicated (McCrory and Lindahl, 2002). These agents have demonstrated efficacy in a variety of pain types and seem to have similar analgesic potency and opioid-sparing benefit but a better safety profile than NSAIDs with respect to the gastrointestinal tract and platelet function, but their effect on renal function is unclear (Kehlet and Holte, 2001). However, treatment with COX-2s has been associated with an increased incidence of myocardial infarction and stroke, which has resulted in the withdrawal of rofecoxib from the market (Krenzischek et al, 2008). It is worth noting that all NSAIDs hold a potential to aggravate any preexisting heart failure and hypertension due to fluid retention through renal effects (Naesh, 2006). This increased risk has led to recommendations that specific COX-2 inhibitors should be used only in the lowest possible dose in patients whom there are no suitable alternatives. Potential cardiovascular effects associated with short-term use of COX-2 in the perioperative setting have not been well studied.

**Local anaesthetics**
The use of local anaesthetics for pain relief is increasingly being extended into the postoperative period. These drugs do not have any specific analgesic effects, but work by blocking the generation and conduction of nerve impulses in all sensory and motor nerve fibres. The smaller unmyelinated nerve fibres are blocked first, which conduct sensation for pain and temperature, before blocking the larger myelinated fibres which conduct sensation for touch, pressure and motor information (Macintyre and Schug, 2007). Local anaesthetics in the perioperative setting can provide analgesia alone or in combination with opioids for epidurals, spinals, peripheral regional nerve blocks and wound infiltration.

**Epidural analgesia**
Epidural analgesia is one of the most effective methods for the management of significant acute pain, such as major thoracic and abdominal surgery, and orthopaedic surgery (e.g. total knee and hip replacements) (ANZCA, 2005). Combined with active postoperative and early enteral feeding, epidural analgesia provided by local anaesthetics (with or without an addition of an opioid) may lead to a reduction in postoperative complications (particularly respiratory and cardiac) and improve patient outcome, especially in the high-risk patient (Macintyre and Schug, 2007).

Combinations of low concentrations of local anaesthetic agents and opioids have been shown to provide consistently superior pain relief compared with either drug alone (Curatolo et al, 1998). The addition of small amounts of adrenaline has resulted in improved analgesia (Niemi and Breivik, 2002), and in some settings, adding clonidine has shown reduction in dose of local anaesthetic and improvement in pain relief (Macintyre and Schug, 2007). Results from major prospective studies have shown that postoperative epidural infusions are safe and effective and can be managed on general surgical wards with few complications, provided that patients are observed and monitored by staff trained in epidural management (Kehlet and Dahl, 2003).

**Intrathecal analgesia**
Spinal or intrathecal analgesia is usually performed prior to surgery to provide anaesthesia for surgery and profound pain relief in the immediate postoperative period. This technique involves a single-shot injection of opioids (and local anaesthetic) into the cerebrospinal fluid avoiding absorption by epidural fat and blood vessels. The dose of opioid administered is much smaller than those required for epidural analgesia and the duration of analgesia depends on the opioid used; generally, analgesia can be expected for up to 24 hours (Table 4) (Macintyre and Schug, 2007). Side-effects are similar to those that occur with epidural opioids.

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**Table 3. Prostaglandins: their organ specificity and effects**

<table>
<thead>
<tr>
<th>Organ specificity</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral nerves</td>
<td>Sensitization and hyperalgesia</td>
</tr>
<tr>
<td>Gastrointestinal tract</td>
<td>Motility, mucosa protection</td>
</tr>
<tr>
<td>Kidney</td>
<td>Medullary blood flow, sodium and potassium exchange, cortical and glomerular blood flow and regulation, sodium retention and water excretion</td>
</tr>
<tr>
<td>Peripheral issues</td>
<td>Inflammatory response</td>
</tr>
<tr>
<td>Coagulation</td>
<td>Fibrinolysis, platelet aggregation</td>
</tr>
<tr>
<td>Uterus</td>
<td>Labour onset, increase contractility in labour</td>
</tr>
</tbody>
</table>

From: Naesh (2006)
Peripheral nerve blocks
Peripheral nerve blocks with intermittent or continuous analgesia with local anaesthetic offer excellent localized pain control and minimize the need for systemic analgesia. These blocks can be performed for numerous types of surgery.

The growing popularity of continuous peripheral nerve blockade may be due to a number of factors, including concerns about the risks of epidural analgesia, the ability to provide selective analgesia with minimal side-effects, patient control and the ability to send day-case patients home with local anaesthetic devices in place. A 'single-shot' nerve block with injection of a local anaesthetic agent is common practice in anaesthesia. Although this may provide many hours of analgesia, in some cases a longer duration of analgesia is required. This can be achieved by leaving a soaker catheter in place and either local anaesthetic given by repeated bolus doses or continuous portable infusion pumps. In the US, patients have been safely discharged home with these devices in place and removed by either home health care or by the patient (Polomano et al, 2008).

Wound infiltration
Infiltration of a wound with local anaesthetic at the end of surgery has been shown to lengthen the time until first analgesic request in a number of procedures. A systematic review found that this was most effective following surgery for inguinal hernia repair, where up to 7 hours of relief was obtained (Moiniche et al, 2008).

Procedures following deeper or intracavity structures, such as hysterectomy or cholecystectomy, showed no benefit and intraperitoneal application after laparoscopic procedures had shown only a short-lasting effect (Moiniche et al, 1998). Continuous wound infiltration with local anaesthetics, using an infusion pump or a disposable elastomeric device, may improve pain relief after operations such as knee ligament reconstruction and shoulder surgery. These systems can be used following abdominal surgery but the addition of a PCA or intermittent opioids may be required to provide adequate analgesia.

Safety concerns
All local anaesthetics are neurotoxic in high concentrations. However, in clinical practice, local anaesthetics when used appropriately and within recommended doses have an enviable safety record (ANZCA, 2005; Macintyre and Schug, 2007). Although relatively rare, the major adverse reactions to local anaesthetics include cardiac dysrhythmias, hypertension, direct tissue toxicity, central nervous system toxicity (e.g. dizziness, light-headedness, paraesthesia, nervousness, disorientation, seizures, coma and even respiratory arrest), and allergic reactions (Krenzischek et al, 2008).

New approaches to pain control
There are a number of novel analgesic delivery systems and pain management techniques available throughout the US and parts of Europe (including the UK). A brief overview will be discussed in this final section.

Long-acting morphine—healthcare professionals should all be familiar with modified-release preparations of oral morphine; now there is a single-dose, sustained-release preparation of injectable morphine sulphate known as DepoDur® (EKR Therapeutics INC, San Diego). This drug is designed to use as a single epidural injection before or during surgery and provides pain relief for up to 48 hours following surgery (Polomano et al, 2008). There is no need for an indwelling catheter for continuous infusion, therefore reducing the need for epidural pumps.

Nasal sprays—opioids, such as fentanyl, alfentanil, sufentanil and oxycodone, are being developed for delivery as nasal sprays. The benefits of this delivery system include a quick onset of action; the system is patient-controlled and there is no need for pumps and infusion lines thereby reducing costs. Clinical studies are needed to confirm the efficacy of this delivery method in the postoperative pain setting (D’Arcy, 2007).

Fentanyl—this is not normally given orally because it degrades in stomach fluids, instead it can be given intravenously via the buccal route or via a transdermal patch. The newest form of fentanyl is Fentora® (Cephalon Inc, Pennsylvania) (fentanyl buccal tablet) which uses an effervescent delivery system called OraVescent® (Cephalon Inc). The patient places the tablet between his/her cheek and gum and the medication is absorbed rapidly. Currently in the US, Fentora® tablets are indicated for breakthrough pain in opioid-tolerant patients with cancer (D’Arcy, 2007). In the UK, Fentora® will be launched later this year, and perhaps in the future it will have a place in postoperative pain management.

Transdermal iontophoresis—iontophoresis is a process that allows for delivery of charged molecules across intact skin using a small electric current. The new fentanyl iontophoretic transdermal system (IONSYS) is a patient-controlled transdermal system using fentanyl. The patch is about the size of a credit card and contains around 80 doses of fentanyl. The system operates for 24 hours or until the 80 doses have been administered. The patch is placed on the patient’s upper outer arm or chest, where the patient can easily activate the delivery button. Each successful dose contains 40μg of fentanyl with a 10-minute lockout programmed into the patch. The device is ideal for short-term acute postoperative pain in adults requiring opioids following surgery, but will not be the system of choice for all patients (Polomano et al, 2008). This new technology will be cost saving as the need for expensive PCA equipment and the training of nurses to care for patients will be reduced.

Elastomeric pumps—these devices are disposable infusion pumps, for example the ON-Q PainBuster® (B Braun Medical Ltd, Sheffield), mainly consisting of an elastometric reservoir in which the solution to be administered is placed, and a flow restrictor system is located in the administration tube set. The combination of both the pressure generated by the filled reservoir and the flow restrictor sets a fixed flow rate of solution. These systems have been used in other areas of healthcare for some time for delivery of medications, but more recently, with the addition of a specially designed wound catheter, have been used for pain management in various surgical procedures postoperatively. The catheter is placed near a nerve or in the

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**Table 4. Intrathecal opioids: examples of doses used**

<table>
<thead>
<tr>
<th>Opioid</th>
<th>Dose (mg)</th>
<th>Onset (min)</th>
<th>Duration (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>0.1–0.5</td>
<td>15–30</td>
<td>8–24</td>
</tr>
<tr>
<td>Pethidine</td>
<td>10–25</td>
<td>5–10</td>
<td>6–12</td>
</tr>
<tr>
<td>Diamorphine</td>
<td>0.5–1</td>
<td>&lt;10</td>
<td>10–20</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>0.006–0.05</td>
<td>&lt;10</td>
<td>1–4</td>
</tr>
<tr>
<td>Sufentanil</td>
<td>0.005–0.02</td>
<td>&lt;10</td>
<td>2–6</td>
</tr>
</tbody>
</table>

*From: Macintyre and Schug (2007)*
wound at the end of the operation. This is then connected to the pump which is filled with local anaesthetic. A continuous flow of local anaesthetic is infused into the wound over a 48-hour period. Some systems allow the patient to self-administer bolus doses as required if breakthrough pain occurs (D’Arcy, 2007). This new technique for pain management has allowed early mobilization and discharge of patients, and, in some circumstances, discharge with the system in place.

**Bupivacaine collagen sponge** – this sponge is designed for implantation directly into the surgical cavity and can be placed at different levels of the wound to provide pain relief to the surgical cavity and can be placed at different pain mechanisms, in order to improve analgesia and potentially reduce side-effects. *Acta Anaesthesiol Stand 42(8): 910-9.*


**Conclusion**

Postoperative pain management continues to be challenging and should be a clinical priority for all healthcare professionals involved in the patient’s journey. Evidence is available of the deleterious effects of poor postoperative pain management. Persistent postoperative pain is a major, largely unrecognized clinical problem, which is distressing and reduces the quality of life of patients and their carers.

There are a number of widely available medications and interventions available for managing postoperative pain; some carry risks of side-effects and serious complications. Effective pain management requires the coordinated effort of a skilled and responsive interdisciplinary team, including medical and nursing staff, physiotherapists, pharmacists and management.

The NHS is driven by targets, in particular waiting lists for surgery; the bed stay for many procedures has been drastically reduced over the last 20 years. With shorter stays in hospital and early discharge there is a need for more innovative ways to reduce postoperative pain. Fortunately, there are new technologies available and more on the horizon. These technologies come at a price and the NHS, in this financially driven climate, have a short-sighted view to introducing new approaches to pain management and many hospitals struggle to implement new interventions.

The evidence informs that good pain relief following surgery will improve the patient’s outcome and recovery and prevent the development of persistent pain, but if acute pain management is to be taken into the 21st century, healthcare professionals have to bravely challenge their organizations so that they can provide appropriate multimodal therapy tailored to the needs of the individual patient.

**KEY POINTS**

- Moderate to severe pain following surgery continues to be problematic for patients and remains a challenge for healthcare professionals working in the perioperative environment.
- Evidence is emerging which links a number of predisposing factors to the development of persistent postsurgical chronic pain.
- The aim of pain management is to combine different treatment modalities, working at different pain mechanisms, in order to improve analgesia and potentially reduce side-effects.
- New technologies and less invasive techniques for pain management are becoming available; therefore, it is essential for nurses to be aware so that patients may benefit from the latest pain relief products.