COMMISSION ON THE PROVISION OF SURGICAL SERVICES

Report of the Working Party on

PAIN AFTER SURGERY

September 1990
MEMBERSHIP OF WORKING PARTY

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The treatment of pain after surgery in British hospitals has been inadequate and has not advanced significantly for many years. This report describes the background to this persistent failure and makes recommendations to improve the situation.
The management of pain after surgery in the UK is unsatisfactory and evidence in this report points to several ways of improving the situation in all hospitals.

All staff involved in the treatment of postoperative pain should be educated more fully in the areas described in this report and traditional antiquated attitudes should be changed. A patient's pain should not be neglected but assessed and recorded along with other observations such as blood pressure and heart rate. In order to ensure this, it is vital that a named member of staff is responsible for a hospital policy which ensures satisfactory pain relief for all patients after surgery. This activity should be audited and appraised continuously.

The advantages of an Acute Pain Service have been described. This service should be introduced in all major hospitals performing surgery in the UK.

The introduction of new effective and safe methods for providing postoperative pain relief should be encouraged.

The advantages of appropriate facilities in the management of postoperative pain have been described. All major hospitals should have a high-dependency unit of sufficient size to support the needs of a modern and effective pain relief policy.

In order to introduce a safe and effective policy, there is a need for properly trained staff and adequate resources.

Research into pain relief after surgery should be encouraged and intensified. There is a need for powerful, safe analgesics and long-acting non-toxic local anaesthetics. If these were available, it is likely that postoperative pain would cease to be a major problem.

There are areas of doubt as to the safety and efficacy of some new methods of analgesia and it is important that research into these techniques should continue. Monitoring of patients to detect undesirable side-effects of analgesic regimens is a major need. The development of inexpensive, easy-to-use monitors to detect the main hazards should be encouraged.

Finally, the use of counselling and psychological methods in the management of postoperative pain is often deficient. These methods may have a useful supportive role and research in this field should be encouraged.
AIMS AND RECOMMENDATIONS

To improve the treatment of postoperative pain in all hospitals by implementation of the following recommendations:

- Improve hospital staff education and challenge traditional attitudes to postoperative pain relief (page 12).
- Assess and record pain systematically, involving the patient whenever possible (page 7).
- Responsibility for the management of pain relief policy after surgery in each hospital given to a named member of staff (page 13).
- Establish acute pain teams in all major hospitals (page 28).
- Introduce new methods and utilise existing methods more effectively giving due regard to safety.
- Audit and continuous appraisal of activity.
- Establish appropriate facilities for the provision of adequate postoperative pain relief in all hospitals (page 30-32).
- Provide properly trained staff and resources for these services.

To continue and intensify research into:

- Development of better and safer drugs to relieve pain (page 33).
- Monitoring of patients after surgery (page 33).
- Safety and efficacy of new methods of pain relief.
- Counselling and psychological methods of pain relief (page 23).
This report concerns all health-care professionals, including hospital managers, involved in the management of patients who are in pain after surgery. It has a message also for the public at large about the present status of the treatment of pain after surgery in the UK.

**EXTENT OF PROBLEM**

Treatment of pain after surgery is central to the care of postoperative patients. Failure to relieve pain is morally and ethically unacceptable. For decades, however, research has continued to show a high incidence of postoperative pain. Paradoxically, the same research often shows a high level of patient satisfaction suggesting that postoperative pain is commonly seen as inevitable.

**TRADITIONAL ATTITUDES AND METHODS**

Traditional methods of pain relief after surgery have depended mainly upon injections of morphine-like drugs. Fears of addiction and respiratory depression may have prevented effective administration. There has been relatively little discussion of pain and its relief in medical and nursing education, the subjective nature of pain has often been overlooked and misconceptions have developed, such as:

1. The doctor and nurse believe they, rather than the patient, are the authority on the patient’s pain.
2. Comparable physical stimuli produce comparable severity of pain in different people and, similarly, equal doses of analgesics will produce equal outcome for all people.
3. Physical signs, physiological or behavioural, accompany pain and can be used to verify its existence and severity.
4. Postoperative pain cannot be prevented.

There is increasing recognition that education in the pharmacology of pain and its sociocultural, psychological and physiological aspects are essential for its effective assessment and relief.

**WHO IS RESPONSIBLE?**

Many health-care professionals are concerned with postoperative pain control so that teamwork is essential. Anaesthetists may initiate and monitor postoperative analgesics and the surgical team are often responsible for subsequent prescribing as the patient’s needs change. Nurses are involved with the assessment and management of postoperative pain and its relief in the widest sense, encouraging the patient to play a role in this as appropriate. The pharmacist should be involved throughout and is an essential resource for doctors, nurses and patients. Other health-care professionals, such as physiotherapists, may also be involved.

Hospital managers are concerned with the implications for resource management with regard to personnel, equipment, staff education and hospital design, so that existing techniques are used more effectively, new ones introduced, and both evaluated.
WHY DISCUSS POSTOPERATIVE PAIN RELIEF NOW?

PERSISTENT FAILURE OF CONVENTIONAL METHODS

Conventional methods of relieving pain after surgery are ineffective in many patients and associated with significant side-effects and there has been little improvement in their efficacy over the years.

BENEFITS, RISKS AND COST OF NEW TECHNIQUES

New techniques have been described over the last 20 years which may improve postoperative pain relief. Although the benefits of some of these innovations may be considerable, they may be associated with undesirable side-effects and can be more hazardous than conventional methods. Most such complications can be prevented or treated if patients are observed and monitored closely.

These various methods need to be assessed and compared in more detail than has been possible in the past. Whilst questions of safety and effectiveness must be paramount, resource implications need also to be identified.

LACK OF PROGRESS AND EDUCATION

Despite the existence of new methods for pain relief after surgery, and greater understanding of the pharmacology of analgesic drugs, there has been little overall improvement in the quality of postoperative pain relief in the UK. Many medical and nursing staff, and most patients, are not aware of the low standard which is achieved in pain relief after surgery, nor of the efficacy and potential complications of the new techniques. In most Medical and Nursing Schools in this country, very little teaching time is allocated to the management of pain relief.

However, in many hospitals, enthusiastic doctors and nurses are beginning to introduce new techniques. It is essential that this should be done in a controlled and safe manner and that a degree of audit should accompany their use.

COMPARISON WITH OTHER COUNTRIES

The situation in the UK is in contrast to that in the USA where treatment of postoperative pain in many hospitals enjoys far greater importance. Teams of doctors, nurses and pharmacists have been formed to treat, or supervise the treatment of, acute pain in every patient in the hospital (Acute Pain Team, page 28). They apply up-to-date techniques and monitor their efficacy and safety.

The National Health and Medical Research Council of Australia have recognised that changes are called for in the management of pain and have recently published a report and recommendations.
WHAT IS THE NATURE OF POSTOPERATIVE PAIN?

DEFINITION OF PAIN

The National Institutes of Health define pain as "a subjective experience that can be perceived directly only by the sufferer. It is a multidimensional phenomenon that can be described by pain location, intensity, temporal aspects, quality, impact, and meaning. Pain does not occur in isolation but in a specific human being in psychosocial, economic, and cultural contexts that influence the meaning, experience, and verbal and non-verbal expression of pain." Each person's response to pain is thus unique and affected by many factors.

INCIDENCE OF POSTOPERATIVE PAIN

Many studies have shown that a significant number of patients experience an unacceptable degree of pain after surgery when it is treated with conventional intramuscular opioid therapy. There has been no apparent improvement since the first study in 1952 (table 1).

Surveys performed in the 1980s reveal an incidence of moderate or severe pain of 31 - 75%. Cohen [1980] reported 75% of patients complaining of moderate to severe pain after abdominal surgery and Donovan [1987] found that in 353 randomly selected medical and surgical patients, 58% had experienced "excruciating" pain. In a recent survey, Seers [1989] found that 43% of patients undergoing elective abdominal surgery complained of "quite a lot of pain" or more on the first day after surgery. Twenty-two percent rated their pain as "very bad" on this day. By the 7th postoperative day, 86% of patients had reported "quite a lot of pain" or more. Similar results were found in a recent Australian study where 37% of patients experienced "severe or unbearable pain" after conventional treatment.

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<th>Table 1. Failure of conventional treatment of postoperative pain (Modified after Tamsen, 1985).</th>
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<td>Peper et al, 1952</td>
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<td>Lasagna &amp; Beecher, 1954</td>
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TYPE OF SURGERY

The site and nature of surgery influences the severity of pain. In general, operations on the chest and upper abdomen are more painful than are those on the limbs and body-surface. However, several so-called minor operations (e.g., haemorrhoidectomy) can result in severe pain and very few studies have compared pain after different procedures.

Because of wide personal variations, pain cannot be predicted by operation and must be assessed individually.

In the management of any particular surgical condition, the operative technique – particularly the type of skin incision – can have a considerable influence on the intensity and duration of postoperative pain.

PSYCHOLOGICAL AND SOCIOCULTURAL FACTORS

Many factors other than pain stimulus can influence the experience of pain. For example, cultural background, past experience, meaning of pain, fear and anxiety, ability to control events and coping strategies can all affect the symptoms. Such factors may help to account for individual differences in response to pain, and for the poor relationship between injury and pain.

Cultural norms regarding behaviour when in pain, and when and where to express pain, are learnt at an early age [Peck, 1986]. For example, a patient may cry out when visited by relatives, but not when attended by the medical staff.

Past experiences, good or bad, of postoperative pain relief can affect later experiences. A patient who has had good postoperative pain relief in the past may react very differently to the prospect of surgery from someone who has had poor relief.

What pain means to each person is important in determining how they will react to it. Pain caused by cancer has different connotations from pain following a hernia repair.

Anxiety and pain are often related after surgery, indicating the need to treat anxiety concomitantly with pain. Many patients benefit from counselling and other techniques considered below.

The amount of control that patients feel they have over their pain is important, as it can reduce anxiety and feelings of dependence. Ultimately, this may have a beneficial effect on postoperative recovery.

‘Coping style’ refers to the strategy adopted in threatening situations. Generally, people either seek further information about the threat or distract themselves from information relevant to the threat.

Attitudes of the nursing and medical staff, responses of other patients to pain and the ward environment have been shown to be major factors in the response to pain [Dodson, 1985].

All of these examples of factors affecting pain can be interrelated and work in a complex way to influence the experience.
HOW CAN PAIN BE MEASURED?

The effects of intervention can be assessed and improved only if some form of measurement of the effect is made (e.g., regular measurement of blood pressure in patients treated with antihypertensive drugs). No such precise measurements of pain are possible. Much reliance is placed on subjective assessments made by nursing staff, which have been shown to be inaccurate (see page 13). Pain cannot be treated or controlled if it is not assessed.

Objective assessment techniques are not available. Changes in plasma hormones have been investigated in the past but do not give an accurate assessment and are inappropriate with rapidly changing pain levels (see page 9). However, simple respiratory function tests may be a useful indicator of pain severity after abdominal and thoracic surgery (see page 8). Posture and facial expression can be observed and are part of the behavioural aspects of acute pain. However, these may not always be reliable cues in isolation.

Since pain cannot be assessed accurately and consistently by observers, no matter how experienced, it is accepted generally that pain severity scoring must be made by the patient. Many techniques have been developed for the measurement of pain and these are used mainly by research workers, although they are in general use in a few hospitals.

The simplest techniques for pain measurement are single-dimensional methods. The patient is asked simply to match pain severity to a scale provided by the observer. Visual analogue and verbal rating scales are used most frequently.

Visual analogue scales have been used widely in the assessment of postoperative pain. The usual practice is to present the patient with a 10-cm long line, the left side of which representing "no pain at all" and the right side representing the "worst pain imaginable". The patient is asked to mark on this scale where he thinks his pain lies in relation to these two extreme points. A modification of this technique involves the use of a scale numbered 0-10. This test requires co-operation and concentration by the patient and some patients find it confusing, especially during periods of distress after surgery. Research workers have found that about 10% of patients have difficulty with this test which has, however, provided much useful information.

A simple verbal rating scale asks the patient to rate pain as "none", "mild", "moderate" or "severe" and has been shown to correlate well with the more complex visual analogue scale.

Multiple-dimensional methods are complex and time-consuming techniques which allow pain to be scaled in at least three dimensions (e.g., sensory, affective and evaluative). Pain is scaled in these dimensions in the McGill pain questionnaire which is the best known and most extensively used method. It is accepted by many researchers that this test is the best way of assessing the quality or character of a patient's pain. However, multi-dimensional techniques have not been evaluated extensively for routine use in the assessment of pain after surgery.

Patients may have less pain after surgery if they lie very still in bed. Therefore, pain is easily underestimated. It is important that severity of pain during movement, breathing and coughing is assessed.

Research has yielded many pain assessment systems, some of which are complex. However, the routine use of a simple system, such as a verbal rating scale, with treatment based on assessment, is essential if progress is to be made in the everyday management of pain after surgery. Pain scores should be entered along with heart rate, blood pressure and other information presently recorded on the patient's observation chart.
WHAT ARE THE BENEFITS OF TREATING PAIN?

HUMANITARIAN

"By any reasonable code, freedom from pain should be a basic human right, limited only by our knowledge to achieve it." [Leibeskind & Meizack, 1987]

It is the basic duty of all health-care professionals to relieve pain and the most important indication for the treatment of pain after surgery is humanitarian. Patients in pain may become demoralised, fatigued and anxious. A recent study showed that pain after surgery interfered with sleep in 70% of patients. Fear of pain makes many patients reluctant to undergo important surgical procedures. Effective pain relief is an essential element of good quality care.

COST EFFECTIVENESS

Pain impedes the ability of patients to mobilise after surgery. Most doctors consider that deep vein thrombosis is less likely and that musculoskeletal function recovers more rapidly in pain-free patients. Patients who are afraid to move in bed are more likely to develop pressure sores. Poor pain relief may result in postoperative complications (see below) which may necessitate admission to an intensive-care unit. Preventing even a small number of these admissions would make significant savings.

It is likely that good postoperative pain relief is associated with earlier discharge from hospital for many patients. Furthermore, a pain-free patient may make less demands on nursing time.

Effective application of appropriate pain relieving techniques will probably allow more operations to be performed on Day-Care Units, without admission to hospital.

RESPIRATORY FUNCTION

General anaesthesia and surgery, especially abdominal and thoracic surgery, have a detrimental effect on respiratory function which lasts well into the postoperative period. Poor pain relief may exaggerate these changes and lead to chest infections, hypoxia, respiratory failure and longer hospital stay.

Studies have shown that poor analgesia impairs respiratory function and improved analgesia has been shown to be associated with a 15-20% increase in vital capacity (maximum breath volume).

Physiotherapy plays a vital role in the prevention of chest complications after surgery. This requires good patient co-operation and this in turn is enhanced by good analgesia.

CARDIOVASCULAR SYSTEM

Pain is often associated with tachycardia and hypertension. This is undesirable in the postoperative period as it may lead to myocardial ischaemia and infarction, particularly in patients with myocardial disease. Some practitioners consider that good analgesia may reduce the incidence of this serious postoperative complication.
GASTROINTESTINAL SYSTEM

Nausea caused by inappropriate analgesia may decrease fluid intake leading to dehydration, and dietary intake may be restricted. Pain may slow the return of normal gut activity after operation, leading to prolongation of the need for intravenous fluids. Good analgesic methods should minimise this problem.

THE STRESS RESPONSE TO SURGERY

Metabolic and endocrine changes are an inevitable response to major surgery. The extent of the response is mainly determined by the degree of tissue trauma, but factors such as emotion, pain, nutritional state and cardiovascular changes are also important. Working on the hypothesis that this response may increase postoperative morbidity and mortality, the effects of several factors on its extent have been investigated, including the effect of analgesia.

The stress response to surgery is not abolished by good analgesia but its severity may be reduced, particularly with the use of epidural analgesia with local anaesthetics.
WHAT IS THE CONVENTIONAL METHOD?

The standard practice is for the doctor to prescribe intramuscular administration of a fixed dose of opioid (see below) on a "prn" (as required) basis. The drug is then given at the discretion of the nurse.

WHAT IS AN OPIOID?

"Among the remedies which it has pleased Almighty God to give to man to relieve his sufferings, none is so universal and so efficacious as opium." (Thomas Sydenham, 1680)

The terminology associated with morphine-like drugs is confusing. "Narco" is a Greek prefix meaning to numb or deaden. Morphine has these properties and the term "narcotic" is often used to describe morphine-like drugs. The name "morphine" is derived from Morpheus, the Greek god of dreams. Morphine is the major active constituent of opium which has been used for the relief of pain for over 2,000 years. Opium is extracted from the juice of a poppy seed and the name "opium" is derived from the Greek word for "juice". Raw opium is a mixture of many compounds and several have analgesic properties (e.g. codeine). All of these naturally-occurring substances are known as "opiates".

Pure morphine was extracted from opium in 1803 and was first synthesised in 1952. Chemists are now able to synthesise morphine-like drugs which are not derived from the natural constituents of opium. The term "opioids" encompasses all naturally occurring opiates and the new totally synthetic morphine-like drugs.

HOW DO OPIOIDS WORK?

Opioids act by attaching to opioid receptors in the central and peripheral nervous system. Several types of opioid receptors have been described but the mu opioid-receptor is the most important for analgesia. Endogenous opioids have been identified and are important physiological neurotransmitters. The side-effects of opioid drugs are due largely to the fact that stimulation of the opioid receptors has many effects other than analgesia.
WHAT IS WRONG WITH THE CONVENTIONAL METHOD?

The problem with conventional treatment of pain after surgery is that it is often ineffective and is associated with many side-effects.

WHY DOES IT FAIL?

Pharmacokinetic Factors

The study of "pharmacokinetics" is concerned with how the body handles a drug ie how it is absorbed, distributed, metabolised and excreted. Pharmacokinetic variation between patients is a major factor in the failure of conventional treatment.

Their are great variations in plasma opioid concentrations after intramuscular injection. For example, studies of multiple injections of pethidine have shown that maximum blood concentrations (an important factor in the effect of a drug) may occur any time between 10 and 90 minutes after a standardised intramuscular injection. Furthermore, maximum concentrations achieved varied four-fold. Peak morphine concentrations are achieved between 4 and 60 minutes after intramuscular injection and peak plasma concentrations vary over 5-fold. The rate at which an opioid is metabolised and removed from the body varies significantly also.

However, although easily measured, plasma morphine concentrations are often a poor reflection of the concentration of the drug at its site of action in the central nervous system. This is another complicating factor.

Because it is impossible to predict the pharmacokinetic behaviour of opioids in an individual, it is not surprising that a standardised regimen, administered to all patients is often ineffective.

Pharmacodynamic Factors

The study of "pharmacodynamics" is concerned with the action of drugs on the body. In each patient, there is a relationship between the plasma opioid concentration and the degree of analgesia and severity of side-effects. Increased concentrations are associated with greater analgesia and increased side-effects. Thus, the lowest opioid concentration which will produce analgesia with minimal side-effects can be demonstrated in most patients. This is known as the minimum effective analgesic concentration (MEAC). It has been shown with several opioids that MEAC values in patients recovering from surgery vary four-fold. These pharmacodynamic factors are similar to the pharmacokinetic variations described above as they are not predictable in most individuals.

Side-effects of Opioids

Opioid drugs have several important side-effects and these are often the reason for the reluctance of doctors and nurses to administer them. Morphine is the opioid which has been studied most.

The respiratory depressant side-effects of morphine may be life-threatening. This may be especially problematical in patients with pre-existing respiratory disorders. The respiratory effects of morphine are dose-related and linked intimately to its analgesic effects. Morphine directly depresses the central medullary respiratory centre in the brain resulting in decreased respiratory rate, tidal volume and minute volume. There is a right shift and reduction in the slope of the carbon dioxide response curve. Respiratory drive is reduced and hypercarbia and hypoxia results. Opioids are associated also with intermittent hypoxia due to obstructive sleep apnoea which is only detectable by continuous monitoring.

Pain is an effective antagonist to morphine-induced respiratory depression and its abolition by other methods (such as local anaesthesia) in patients receiving large doses of opioids has been followed by respiratory depression.
Morphine and other opioids suppress the cough reflex and are often used as antitussives. However, this is an adverse effect after surgery as an active cough reflex will reduce the risk of chest infection.

Morphine and other opioids have a profound effect on the gastrointestinal system. Nausea and vomiting is caused by direct stimulation of the chemoreceptor trigger zone in the area postrema of the medulla. Nausea and vomiting may be troublesome particularly when the patient sits up in bed or tries to mobilise. Tolerance to these side-effects may develop in a few days but this is of little comfort to most patients immediately after surgery. It is common practice to prescribe an antiemetic to be given concomitantly with morphine in the postoperative period. Pain per se may cause nausea and vomiting.

All opioids are potent inhibitors of gastric emptying and gastrointestinal motility. This may increase the risk of inhalation of gastric contents and aspiration pneumonia. The absorption of fluids or drugs administered orally will be delayed or abolished. Morphine causes spasm of the bowel wall and there is some evidence that its use in the postoperative period is associated with anastomotic breakdown and paralytic ileus.

Morphine causes spasm of the sphincter of Oddi and the biliary tract and biliary colic may occur. Urinary sphincter pressure is increased and retention of urine is a recognised complication.

Morphine can induce sedation in the postoperative period. Mild sedation may be beneficial but marked sedation reduces the patient’s ability to co-operate. It is important to recognise that sedation may also be the result of opioid-induced respiratory failure.

Addiction to opioids concerns not only the patient but the nurse and doctor. This concern is exaggerated as addiction to opioids after administration for postoperative pain is very rare. Its overall incidence is probably about 1 in 3,000. It has been argued that those who administer opioids are at greater risk of developing addiction than those who receive them.

Pleasant euphoria is often associated with opioids but occasionally dysphoria and hallucinations occur. This is a rare reaction with morphine but is more frequent with the newer opioids (page 18).

Pruritus can occur after morphine administration particularly after epidural injection.

Morphine may lead to arterial and venous dilation causing hypotension. A recent survey (see below) showed that 75% of nurses thought that blood pressure was the vital sign affected most by opioids. Only 11% thought that respiratory rate was affected most. Other opioids affect the cardiovascular system to a lesser extent.

**Staff Attitudes and Knowledge**

In 1985, a questionnaire was sent to 302 qualified nurses in the Lancashire and Kendal districts who were involved in the treatment of postoperative pain to elicit their current practice, opinions and knowledge of the subject (Cartwright, 1985). Seventy percent of the nurses responded.

In general, knowledge was good. However, 24% of nurses thought that they should not give injections for longer than 36 hours after surgery and 74% after 48 hours. Only 7% answered that they should be given for as long as the patient requires them. This may reflect the fact that 26% of nurses had reservations regarding opioid addiction, despite its low incidence.

Fifty-seven percent replied that they would not give prescribed analgesics when the patient was not in pain. This may result in poor pain relief as pharmacological factors dictate that the best control is achieved by giving the analgesic before the previous dose has worn off.
Another problem, with the intramuscular route, is the dislike of patients for needles; 52% of nurses thought that, in some instances, patients preferred pain from the operation to pain from an injection.

The estimated average number of analgesic injections after operation was less than 4 (34% of nurses), 6 (24%), 8 (11%) and more than 8 (5%). This probably represents undertreatment in many patients.

Prescribing habits by doctors could be improved (90% of nurses). Suggestions included more clearly expressed prescriptions (47%), clearer writing (66%), shorter time intervals between doses (38%) and more effective drugs. Only 13% called for more doses and only 10% for larger doses.

Even if "as required" analgesics are prescribed adequately, they may not always be given. Studies have shown that nurses frequently administer a lower dose at longer intervals than that prescribed.

In a study of 207 qualified nurses in Canada, Watt-Watson [1987] also found lack of knowledge about pain assessment and narcotic administration.

Patients are not always involved in assessment of their pain. Less than 50% of the patients in the study by Donovan [1987] were asked about their pain or had it noted by any member of the health care team. Furthermore, there is often a lack of agreement between nurses’ and patients’ assessment of pain severity. Seers [1989] asked 221 nurse-patient pairs to rate the patient’s pain. The mean ratings of the nurses were consistently and significantly lower than those made by the patients.

Nurses may sometimes consider the patient who asks for pain relief frequently, or because the last dose has not worked, as being "wimpish." Also patients may not ask for analgesia because they are afraid of being thought cowardly.

The majority of medical house officers will have had very little education in postoperative pain relief. They will have had some lectures on opioids during their Pharmacology or Therapeutics course and during an anaesthetic attachment. They may have had some experience of analgesia during a medical residency but this may not be relevant to the care of postoperative patients. After that, they probably receive little or no supervision and are reluctant to admit that they are not controlling a patient’s pain. They may be either reluctant to administer other than timid doses of analgesics or unaware of the dangers of larger doses. More experienced junior doctors may not involve themselves in the day-to-day management of pain.

The question whether to give prophylactic analgesia to a patient who is not in pain is not addressed by medical and nursing staff, nor is the time it takes for an analgesic to take effect. In some ward settings, the giving of analgesia is seen to be an interruption of scheduled work.

**Logistical Factors**

It is often unclear who is responsible for the management of a patient’s pain. In general, the anaesthetist prescribes the regimen and then hands over responsibility to ward medical staff who are often the most junior. The responsibility is in turn handed to the nursing staff.

There seems to be little knowledge of the different modalities of pain relief and those who probably know most about it (the anaesthetists) do little except indicate what they consider to be appropriate for the early postoperative period. They are not usually concerned with the further management.
It takes time to administer opioids because a strict checking procedure must be carried out by a trained nurse at each administration in accordance with local hospital procedures. In the Lancaster and Kendal survey, 38% of nurses said that the ward staffing level adversely affected the amount of analgesics given.

Other Factors

It is difficult to quantify pain and the end-point of treatment is difficult to define. Routine observations, such as blood pressure and urine output, are charted regularly after surgery but it is not standard practice to record the degree of pain and its response to treatment. Consequently, pain is not discussed routinely on the ward-round and treatment efficacy cannot be audited.

Finally, analgesic requirements vary considerably with the type of surgery and standardised intramuscular regimens cannot account for this in many patients.

HOW CAN IT BE IMPROVED?

There are many reasons for the failure of the conventional method of treating pain after surgery. It cannot allow for the substantial variation between patients in analgesia requirement. Large inter-patient variation in pharmacological properties of opioids, psychosocial components and the logistical elements in the administration of opioids are major factors. Serious side-effects limit the use of opioids. Staff and patient attitudes and lack of pain assessment and audit are also of importance. However, these problems can and must be overcome, because the advantages of treating pain far outweigh the disadvantages.

In order to improve the efficacy of opioid administration, the dose and frequency should be adjusted in response to the needs of each patient who should have an individualised treatment regimen. Efficacy and side-effects should be recorded regularly and treatment modified accordingly. Pain and its relief should be discussed with the patient, both before and after surgery and there should be an emphasis on prevention.
WHAT METHODS ARE AVAILABLE TO TREAT ACUTE PAIN?

There are many ways of treating pain after surgery. Each technique will be described briefly with an account of its advantages, disadvantages, efficacy and current status in the UK.

OPIOIDS

Intramuscular Injection

This is the conventional method for the administration of opioids after surgery. It has been described in earlier sections.

Oral

Most opioids can be given orally and chronic pain associated with diseases of the terminally-ill is treated in this way. Opioids can be given as a solution or tablet and an oral formulation is available which is designed to release morphine slowly as it passes through the gut. It is not common practice to administer opioids orally after surgery. Some practitioners have reported satisfactory analgesia using this route but it is accepted generally that oral opioids are not applicable in this context.

Patients prefer the oral route of administration to injections but, in order to be absorbed, it must pass from the stomach into the small intestine. Vomiting and delayed gastric emptying, which are frequent after anaesthesia and surgery, will frustrate this. When emptying recovers, several doses of opioids may be dumped from the stomach into the intestine, leading to an overdose.

Oral opioids may be of use when gastric function recovers and pain is less severe, but large doses may be needed as morphine is metabolised in the walls of the intestine and liver before entering the bloodstream (first-pass metabolism).

Intravenous Infusions

This technique involves the delivery of a solution containing an opioid into the patient’s circulation through an intravenous cannula.

If a drug is administered at a constant rate it will eventually reach a steady concentration when the rate of delivery is equal to the rate of removal by the patient’s liver and kidneys. In theory, the steady concentration achieved will be sufficient to provide good continuous pain relief without serious side-effects. The rate can be adjusted by the physician or nurse if analgesia is unsatisfactory or side-effects occur.

Intravenous infusions are used in several hospitals in the UK, particularly after major surgery. They can be very effective in relieving pain.

The main advantage of this technique is that opioid administration is guaranteed and it is relatively simple and easy to apply.

However, there are significant disadvantages associated with intravenous infusions. It takes several hours for the plasma concentration of most opioids to reach a steady-state and concentrations continue to increase well into the postoperative period. Therefore, serious respiratory depression may occur some hours after the infusion is begun, often during the night. Respiratory depression and hypoxia are a complication of all opioid techniques, but recent work suggests that this is associated particularly with constant rate intravenous infusions. Therefore, it is essential that careful respiratory monitoring is undertaken during infusions.
Paradoxically, because the rise in plasma opioid concentration is often slow, the infusion may not provide adequate analgesia immediately after surgery. Intravenous boluses of opioids may be used at this time to "top-up" the infusion. As with all electrical devices, the pump may malfunction or be set incorrectly.

**Patient-Controlled Analgesia**

Patient-controlled analgesia (PCA) was developed 20 years ago but has gained popularity only recently. PCA systems deliver opioids at a rate which is controlled by the patient. Considerable variation between patients in minimum effective analgesic plasma concentrations of opioids has been described (page 11). The theoretical basis of PCA is that the patient will titrate the delivery of opioid to achieve plasma concentrations consistent with good analgesia and minimal side-effects.

The opioid is contained within a delivery system which will administer a preset dose when a button is pressed by the patient. Most systems consist of a sophisticated electronic pump which drives a syringe or vial containing the opioid. Smaller portable devices are available also.

A PCA regimen requires consideration of bolus dose, lock-out interval, background infusion rate and maximum dose. The bolus dose is the dose delivered by the machine when the patient presses the button. The lock-out time is that period, after a dose has been given, during which any further demands by the patient will be ignored by the machine. This enables the opioid bolus to have an effect before another is given. Most machines enable a background infusion of opioid to be delivered independent of patient demand and this may improve the efficacy of the technique. Maximum dose facility is available on most systems. The machine will not deliver more than the maximum preset dose over a period of time.

Several studies have shown improved efficacy, reduced dosage of opioid and earlier discharge from hospital compared with routine intramuscular therapy. However, such studies are difficult to control and many practitioners are of the opinion that the major advantage of PCA is patient satisfaction. Whether PCA improves pain-relief compared with other techniques is often debated, but it is accepted generally that patients treated with PCA experience less anxiety and discomfort. Analgesia is readily available and the delay associated with nurse-administered intramuscular analgesia does not occur. PCA devices are usually accepted enthusiastically by patients and staff.

The approximate cost of a PCA machine is £2,000 and there is potential for malfunction and user-error. Continuous in-service training of staff is essential in order to detect rare cases of equipment malfunction and to minimise error. The use of PCA may save nursing time. However, ensuring good analgesia and monitoring respiration continue to be a priority for nursing staff. Some patients are not able to operate the device, and other regimens have to be substituted.

Despite the theoretical safety of this technique, and in common with any other form of opioid analgesia, respiratory depression can occur, particularly when a background infusion is used, as this removes total control of delivery rate from the patient. Therefore, regular monitoring of respiratory function and degree of sedation is essential.

The place of PCA in the treatment of pain after surgery is still to be established in the UK. However, many consider PCA as a major advance, providing analgesia comparable to epidural opioids (see below) with fewer major and minor side-effects.

**Spinal Opioids**

Opioid receptors are present in the spinal cord and opioids may produce analgesia by acting at these sites. Opioids can be injected into the fluid surrounding the spinal cord (cerebrospinal fluid) or into the epidural (extradural) space. A firm membrane (the dura-mater) surrounds the spinal cord and cerebrospinal fluid, the space between this membrane and the bone of the spine being the epidural space. Catheters can be inserted in this space to allow continuous infusions.
of drugs. The term “spinal opioids” refers to the use of opioids in the epidural space or in the cerebrospinal fluid. The benefit claimed for the use of these techniques is that good analgesia can be obtained with small doses. It was hoped that the incidence of side-effects would be reduced but this has proved not to be the case.

Spinal opioids are used in more than 94% of Swedish hospitals and in many obstetric units in the USA. There are no comparable figures in the UK, but the epidural route is a popular method of providing postoperative pain relief, especially after Caesarian section and thoracic and upper abdominal surgery.

Spinal opioids are effective and many studies describe analgesia which is significantly better than that produced by parenteral opioids, although it is not always possible to exclude bias in the interpretation of the results. Nevertheless, a substantial body of opinion believes that spinal opioids produce superior analgesia.

Hypotension is not a problem (see local anaesthesia) and apparatus for continuous infusion of drugs is available readily.

Disadvantages of spinal opioids include instances of incomplete analgesia and large inter-patient variability in response. The technique is time-consuming, there may be technical difficulties and infection of the epidural space is a remote possibility. There is a high incidence of nausea and vomiting, pruritus and urinary retention. The last is a particular problem as it may necessitate bladder catheterisation.

The most important, and potentially fatal, complication of spinal opioids is respiratory depression. Depression occurring shortly after administration is associated with many opioid techniques but with spinal opioids it may be considerably delayed (many hours after the injection). This complication is particularly associated with morphine.

**Continuous observation and monitoring of patients receiving spinal opioids is essential.**

**Rectal Opioids**

Several rectal formulations of opioid and non-opioid analgesics are available in the UK. They are used infrequently. The drug is absorbed to a very variable extent from the rectum directly into the bloodstream and the aim is to produce a steady-state drug concentration. However, the efficacy of this technique is not established.

**Transdermal Opioids**

Transdermal drug delivery involves the application of a drug-containing patch which adheres to the skin. The drug diffuses through the skin and to the blood at a rate dependent on the design of the patch. At present, a patch containing the fat-soluble synthetic opioid fentanyl is undergoing clinical trials. The aim of this technique is to provide a steady concentration without the need for venous access or syringe-pumps. This method has been shown to be as effective as continuous intravenous infusions.

There are several problems with transdermal fentanyl. Unlike an intravenous infusion, the dose cannot be titrated to the patient’s needs and it takes several more hours to achieve effective plasma concentrations. Therefore, the patch must be applied before surgery. Plasma concentrations fall only slowly after the patch is removed, which may be a problem if overdose occurs.

**Sublingual and Buccal Administration**

Drugs can be incorporated into a tablet which, when inserted under the tongue or beside the gum, will release the drug directly into the bloodstream. Buprenorphine, phenazocine and morphine can be given in this way.
Sublingual buprenorphine is used often for the treatment of pain after surgery and some studies have found it to be satisfactory. However, it is generally believed that buprenorphine is not as effective as morphine; nausea, vomiting and sedation are particularly troublesome. The use of buccal morphine is not established and there is evidence to suggest that it is not likely to be particularly effective.

The major advantage of this technique is that first-pass metabolism (page 15) is avoided and if overdosage occurs the tablet can be removed easily. However, the drug may dissolve in saliva which is then swallowed resulting in poor absorption.

NEW OPIOIDS

The treatment of acute pain will be improved by the development of effectiveness analgesics which are free from side-effects, particularly respiratory depression. This has been and remains the subject of considerable research.

Many new opioids have been developed and are available generally for the treatment of acute pain.

Mixed Opioid Agonist-Antagonist and Partial Agonist Drugs

Morphine and other opioids produce their effects by binding to opioid receptors on cells within the nervous system. This results in a change inside the cell and ultimately in most of the opioid effects described. However, several types of opioid receptors exist and stimulation of these, either alone or in various combinations, produces different effects such as analgesia, respiratory depression, sedation, euphoria, dysphoria and dependence. The properties of a particular opioid depend to a large extent on the receptor or group of receptors to which it binds.

Drugs which bind to and stimulate opioid receptors are known as opioid agonists (morphine, diamorphine, pethidine). Opioid antagonists are drugs which bind to opioid receptors without causing an effect within the cell. Consequently, they may displace opioid agonist drugs from their site of action and reverse opioid-induced effects. Naloxone is a pure opioid antagonist and is used to treat many of the unwanted and potentially harmful side-effects of opioids.

Nalorphine has for many years been known to act as an opioid antagonist at low doses. However, it was discovered in the 1950s that this “antagonist” had mild analgesic or agonist properties, especially in large doses and increasing the dose further resulted only in respiratory depression. Knowledge of nalorphine led to the concept of mixed agonist-antagonist opioids and the search for drugs which may provide good analgesia with no respiratory depression or potential for addiction.

As described previously, the most important receptor responsible for analgesia is the mu receptor. However, this is responsible also for respiratory depression, euphoria, dependence and inhibition of gut motility. Two types of mu receptors (mu-1 and mu-2) have been identified and it may be that mu-1 receptors are responsible for pain relief without respiratory depression. Stimulation of other receptors produce analgesia with no respiratory effect. For example, the kappa receptor is responsible for analgesia, dysphoria and sedation and the delta receptor for analgesia and dependence. It is thought that certain of the agonist-antagonist opioids act by stimulating opioid receptors responsible for analgesia but not respiratory depression.

Some opioids may exhibit a ceiling effect when stimulating opioid receptors producing a certain degree of analgesia with less respiratory depression. These drugs are known as partial opioid agonists. The distinction between mixed agonist-antagonist and partial opioid agonists is blurred and their pharmacology is very similar. Many such opioids have been developed and several are available generally. They include buprenorphine, meptazinol, pentazocine and nalbuphine.
Unfortunately, the usefulness of these drugs in the treatment of pain after surgery has been disappointing. The main problem is that they are weaker analgesics than morphine and pain relief after intermediate to major surgery is often unsatisfactory. In addition, side-effects (the nature and degree of which depend on the receptor or receptors affected by the drug) can be troublesome. These include nausea, vomiting, hallucinations and dysphoria. Respiratory depression is less likely, but this is at the expense of weaker analgesia. It can be treated with naloxone or doxapram (a respiratory centre stimulant).

**Pure Agonists**

Many synthetic pure opioid agonists have been developed and it is accepted generally that these agents differ from morphine and each other mostly in their relative potencies and pharmacokinetics. They have the same side-effects as morphine. The only advantage that these offer in the treatment of postoperative pain is their shorter duration of activity so that the control of intravenous infusions can be more precise.

**NON-Steroidal ANTI-INFLAMMATORY DRUGS**

Non-steroidal anti-inflammatory drugs (NSAID) relieve pain by two mechanisms. They have analgesic properties, which are weaker than opioids, and they inhibit inflammation which may be a cause of pain after surgery. Aspirin and indomethacin are the oldest drugs in this class and their relatively low efficacy limited their use in the postoperative period. However, new drugs of this type have been developed and interest in their use has increased recently. Such drugs include diclofenac, piroxicam and ketorolac.

Because of their relatively low efficacy, NSAIDs are not suitable as sole analgesics immediately after major surgery. However, they may be of considerable value 24-48 hours later and they are of particular benefit following orthopaedic and thoracic surgery. Many consider NSAIDs as suitable adjuvants to conventional analgesia and of particular use for dental or day-case surgery.

The use of these drugs carries several advantages. NSAIDs are not subject to Controlled Drug Regulations and can be prescribed and administered easily. Many are long-acting and can be given once or twice daily. Unlike morphine, they do not depress gastrointestinal function and there is no risk of addiction. Respiratory monitoring is not required as they do not depress respiration. They can be given orally, rectally and intramuscularly, though the latter is often painful. If used in conjunction with opioids, they will reduce opioid requirements significantly and may lessen the incidence of opioid-induced side-effects.

**Significant disadvantages associated with NSAIDs include gastric ulceration, impairment of renal function and impaired blood clotting due to inhibition of platelet function. The clinical relevance of these side-effects is still to be established. A strong association with Reye’s syndrome means that salicylates must never be used as analgesics in children.**

**LOCAL ANAESTHESIA**

**What is a Local Anaesthetic ?**

Local anaesthetic drugs block the conduction of impulses along nerves. All types of nerve fibres are affected, but the sensory and autonomic nerves are more sensitive than motor nerves to the action of local anaesthetics. Therefore, a local anaesthetic drug injected close to a nerve or plexus of nerves will block painful stimuli arising from the area supplied by that nerve.

Local anaesthetic drugs used most commonly in the UK are lignocaine, prilocaine and
bupivacaine. The duration of action of these drugs varies, but most local anaesthetic blocks wear-off within 2-3 hours. However, some blocks may produce useful analgesia for 8-12 hours. The block reverses as the drug diffuses away from its site of action into the blood and mixing a small dose of adrenaline with the local anaesthetic solution may inhibit this process and increase the duration of the block.

What are the Advantages of Local Anaesthesia?

Analgesia is often profound and the patient experiences no pain whatsoever arising in the area supplied by the nerve, as all sensory stimuli are blocked. Local anaesthetic drugs are not associated with opioid-like side-effects (respiratory depression, nausea, vomiting and sedation) when used in normal effective doses.

It is generally accepted that, of all the techniques available at present, analgesia produced by local anaesthetic drugs provides the most satisfactory pain relief in many situations, especially in the immediate postoperative period. Respiratory function in particular may be improved with these techniques.

Why is Local Anaesthesia Not Used After Every Operation?

Unfortunately, there are many problems associated with the use of local anaesthesia which limit its application, but there is no doubt the method could be used more frequently. A major difficulty is that not all pain arises from areas supplied by superficial nerves, particularly after major surgery. Wound pain can be blocked relatively easily but painful impulses arising from damaged internal tissues and organs are not blocked by this technique. However, epidural analgesia (see below) may solve this problem.

Local anaesthetic drugs have potentially fatal side-effects when given in large doses. Toxicity is associated with numbness of the tongue and mouth, light-headedness, tinnitus, visual disturbances, slurring of speech, muscular twitching, irrational conversation, unconsciousness, grand mal convulsions, coma and respiratory arrest. Furthermore, local anaesthetics depress myocardial function and may cause cardiac arrest, especially if given intravenously. Bupivacaine is particularly associated with cardiac problems.

Because of this toxicity, the volume of local anaesthetic solution that can be used is limited. Unfortunately, the volume of solution required to block all nerves supplying painful areas may be greater than the safe dose.

The short duration of action of local anaesthetic drugs is another problem. Most surgical procedures are painful well after the effect of the local anaesthetic has ceased, so that the block must be repeated or opioid analgesia given. However, many practitioners believe that patients who have had local anaesthesia after surgery experience less discomfort during the period when the block is no longer effective. Continuous analgesia can be provided in some situations by the use of catheter techniques. Clearly, the development of a non-toxic local anaesthetic drug with a prolonged duration of action would be a considerable advance.

The performance of any particular nerve block is associated with its own complication; the needle may damage or enter structures in close proximity to the nerve. Such complications include intravenous or intra-arterial injection of local anaesthetics, pneumothorax, haemorrhage, infection and permanent nerve damage. Some techniques are time-consuming and require considerable skill but others are quick and simple to perform.

What Local Anaesthetic Techniques Are Available?

Local anaesthetic drugs can be used to produce analgesia by infiltration of the operation site, blocking peripheral nerves or by an epidural technique.
Local Infiltration

Infiltration of the wound is a simple technique performed by the surgeon at the end of the operation. The wound is injected or sprayed with local anaesthetic and analgesia of short duration results. Alternatively, catheters may be placed adjacent to the wound through which local anaesthetic drugs may be infused or injected intermittently. This will provide good continuous relief of pain arising from the wound itself. Interest in this technique has increased recently and several practitioners believe that it is a useful supplement to opioid therapy but there is still concern regarding the increased risk of infection.

Catheters can be inserted adjacent to the pleura (lining of the lung) and provide good analgesia after upper abdominal surgery. The place of this technique in routine clinical practice is still to be established.

Nerve block

Individual or groups of peripheral nerves may be blocked to provide analgesia after many operations. This is usually performed by the anaesthetist whilst the patient is under general anaesthesia. Single blocks are performed by injecting anaesthetic solution around the nerves using a needle. In several situations, it is possible to place a catheter adjacent to the nerves to allow prolonged analgesia. Excellent pain relief can be provided by this technique in situations such as hernia repair and after surgery on the arm, leg or chest.

Epidurals

The epidural technique has been described in the section concerned with opioids (see page 16). Local anaesthetic solution introduced into the epidural space via a catheter will block the nerves as they leave the spinal canal and before they separate into superficial and deep branches. Consequently, blocking nerves in this region with local anaesthetics will result in analgesia around the wound and in the deep tissues as well. The epidural space is confined and many nerves will be affected by the introduction of a relatively small dose of local anaesthetic. Excellent analgesia results from this technique.

Local anaesthetic solution can be injected into the lower levels of the epidural space by a needle inserted at the base of the spine. This is known as a "caudal block" and is used frequently by many practitioners to provide a period of excellent analgesia after procedures such as haemorrhoidectomy and circumcision.

Unfortunately, there are several problems which limit the use of epidural local anaesthesia. Potentially serious hypotension is a major complication. Normal blood pressure is maintained in part by the tone of the smooth muscles in the walls of the small arteries (arterioles). These muscles are stimulated to contract by sympathetic nerves which lie in the epidural space alongside the sensory nerves. Sympathetic nerves are very sensitive to local anaesthetics and sympathetic nerve block is an inevitable consequence of analgesia. Because many nerves are affected in epidural blocks, a considerable number of arterioles will loose their muscle tone and dilate, resulting in a fall in blood pressure. The severity of the fall depends on many factors including the position of the epidural, state of hydration, age and general condition of the patient. Hypotension may be controlled by the use of intravenous fluids and drugs which stimulate cardiac output and increase the arteriolar muscle tone. Careful and continuous monitoring of blood pressure is therefore essential during epidural analgesia with local anaesthetics. This is in contrast to opioid epidurals where respiratory depression is the main danger.

Occasionally, a significant volume of local anaesthetic solution may be introduced directly into the cerebrospinal fluid with this technique. This is likely to cause severe hypotension and profound generalised paralysis which may require immediate intubation and ventilation. Therefore, it is essential that medical personnel trained in advanced resuscitation techniques should be instantly available when an epidural is in situ.
Other complications of epidural blocks may include infection, subdural haematoma, muscle weakness in the area supplied by the blocked nerves and intravenous injection or accumulation of local anaesthetic with associated side-effects.

Recent research has suggested that a combination of local anaesthetic and opioid solution introduced into the epidural space will produce good pain relief using relatively small doses of both drugs. This may reduce the incidence of side-effects significantly.

**TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION**

Transcutaneous nerve stimulation (TENS) involves the application of electrodes to the skin over the area of pain. A small electrical current is passed between the electrodes which stimulates local sensory nerves. This technique was developed after the introduction of the gate control theory of pain by Melzack and Wall in 1965 and it is well established in the treatment of chronic pain. Its use in acute pain was reported originally in 1974, but there have been few well controlled studies on its efficacy. It may be of use in reducing the need for opioid analgesia but a recent well controlled study has shown no difference in this regard compared with placebo in patients after laminectomy.

The advantages of TENS are that it is simple, non-invasive and not associated with any opioid-like side-effects. Complications are rare but allergic reactions to the electrode, electrical burns and equipment failure have been described. It is probably best avoided in patients with cardiac pacemakers.

Clearly, TENS is not effective as the sole treatment for moderate or severe pain after surgery.

**CRYOANALGESIA**

Cryoanalgesia was described in 1976 and is defined as the use of low temperatures to block conduction in a peripheral nerve reversibly in order to relieve pain. A special needle (cryoprobe) is applied directly to the nerve and the temperature (-70°C) disrupts the internal structure of the nerve. Good, but not complete, analgesia is produced in the distribution of the nerve. The duration of nerve block and associated analgesia is one to six months. All studies in animals and man have shown that normal function of the nerve returns after cryoanalysis. Any muscle supplied by the nerve will be paralysed and atrophy during this time, so that the use of this technique is limited to sensory nerves. Cryoanalgesia has been used after thoracotomy and significant benefit has been reported from its use. However, only a few enthusiasts continue to advocate it.

The advantages of cryoanalgesia is that it is safe and beneficial, particularly during physiotherapy. Opioid requirements are reduced and there is no need for intensive observation and monitoring. However, resultant analgesia is not complete and not all postoperative pain is confined to the distribution of sensory nerves. Its use is limited to sensory nerves and is time-consuming. The duration of numbness may concern patients and neuralgia after cryotherapy has been reported.

**INHALATION ANALGESIA**

Several inhalation anaesthetics are analgesics in the conscious patient if inhaled in small concentrations.

Nitrous oxide administered by face mask in oxygen 50% (Entonox) is self-administered by patients in labour under the supervision of midwives, by first-aid workers at the site of accidents and occasionally for pain after surgery. It is not possible to administer this agent continuously because of technical problems and the effect of nitrous oxide on the bone marrow. However, during short periods of severe postoperative pain, such as may occur during physiotherapy or removal of drains or dressings, this method can be useful.
It is simple to administer and the effect is rapid. However, apart from prolonged sedation and depression of the bone marrow, concern also exists regarding toxic effects to staff and the long-term influences on global pollution.

ACUPUNCTURE

Acupuncture is used by many practitioners for the treatment of chronic pain but studies concerning the efficacy of this method are often poorly controlled. There has been only slight interest in the Western World in the use of acupuncture for pain after surgery. Modern practitioners use needles stimulated electrically by a pulse generator, known as "electroacupuncture", in a recent well controlled study, electroacupuncture performed before reversal of anaesthesia reduced postoperative opioid requirements in the first two hours after surgery by 50%. Thereafter, it had no effect.

Acupuncture may have a role as an adjunct to conventional treatment but it not likely to be useful as the sole technique for the treatment of moderate to severe pain after surgery.

COUNSELLING AND PSYCHOLOGICAL METHODS

These are defined as perioperative interventions such as information giving, training in relaxation, distraction and coping techniques and psychological support. They affect how patients think, feel and act. They either change the way in which sensations are experienced and evaluated, or alter patients' motor behaviour thus reducing pain on movement.

Various psychological methods have been evaluated and are listed as information, behavioural instructions (especially relaxation), cognitive methods and psychotherapy.

Information of two main types has been given: procedural (what will be done, when, where, by whom and with what apparatus) and sensory (what sensations will be experienced). Information is thought to be effective in reducing the fear of the unknown and in allowing patients to plan how they will cope, giving a sense of predictability and control. Information and support can be reinforced by a booklet given before surgery.

Behavioural instructions, such as relaxation, provide specific ways of responding. This may work by reducing muscle tension, distraction from pain and giving a greater sense of control over the pain.

Cognitive methods alter thoughts about events, for example, distraction or focusing on positive rather than negative interpretations.

Psychotherapy approaches the patient's emotional responses either by encouraging them to talk about their feelings and worries, or by having groups of patients share their concerns.

Randomised controlled trials have shown that information, behavioural instruction including relaxation and cognitive methods are all effective in reducing postoperative pain. Too few controlled trials of psychotherapeutic methods have been done to assess potential benefits. All four methods of psychological preparation have been shown to be effective in reducing requirements for analgesic medication. Benefits have also been demonstrated with a wide range of other outcomes including length of stay in hospital, recovery, physiological indices, patient distress and patient satisfaction with care.

While some of the components of these methods are included in current clinical practice, their systematic use with adults is still largely on an experimental basis. Nurses are not routinely taught skills such as relaxation and distraction, and there is a shortage of nurses with the relevant skills to carry out these methods. Some expertise in psychological methods should be available in surgical units, ideally with at least one nurse on duty who has some training in this area with the back-up of a clinical psychologist.
It seems common-sense that psychological support and treating patients as individuals will help patients after surgery and many of these techniques are applied subconsciously by many caring nurses and doctors.

The added effort of incorporating counselling and psychological techniques into normal care is small, and they are therefore an efficient method of obtaining both clinical and economic benefits. Major developments required are guidelines for routine practice, training for nurses in the relevant skills, clinical psychologist back-up and research on implementation of these methods.

HYPNOSIS

Hypnosis is a difficult and time-consuming technique but may have spectacular effects in susceptible subjects. It is not in general use in the UK and its efficacy in the treatment of postoperative pain is not known.
PAIN RELIEF IN CHILDREN

DO CHILDREN SUFFER PAIN AFTER SURGERY?

Many children undergo surgery and there is nothing to suggest that their pain threshold is higher or experience of pain less intense than adults. Several studies have shown that pain after surgery is treated poorly in children. Data from these studies suggest that weaker oral analgesics are relied upon more frequently in children and fewer and relatively smaller doses of opioids are given compared with adults.

In children treated with conventional methods, Mather and Mackie [1983] found that 75% of children were in pain on the day of surgery and 13% were in severe pain. More children (17%) were in severe pain on the day after surgery. This and other studies have generated a greater awareness of this problem and many practitioners are attempting to improve the quality of pain control in children after surgery.

WHY IS PAIN RELIEF A PARTICULAR PROBLEM IN CHILDREN?

All the factors which are responsible for the failure of conventional techniques in adults apply also to children. However, several of these factors are exaggerated in children. Pain is an important learning experience in children and influences future attitudes to medical care.

It is considerably more difficult to assess pain severity in children. Many children cannot express their pain verbally and crying may be associated with other emotions such as loneliness, fear or anxiety. This is particularly so in pre-school children. It has been suggested that a specific "pain cry" may be identified by trained observers. Children may become withdrawn and motionless when in pain and this may be mistaken for good pain control. Standard visual analogue scales for pain are of limited use in young children but some simple scales have been developed and used successfully. However, the problem of communication between adult and child remains a major problem.

Nurses and doctors are more reluctant to give injections to children who may fear injections more than postoperative pain. Indeed, children may feign absence of pain to avoid injections. Unfortunately, regular injections are required if conventional treatment is to succeed.

Oral analgesics are prescribed more frequently and earlier after surgery in children. These drugs may be absorbed poorly because of delayed gastric emptying in the postoperative period.

WHAT OTHER METHODS CAN BE USED IN CHILDREN?

Many of the techniques described earlier can be used in children and the advantages and disadvantages of each technique still apply. However, several methods are of particular use in children.

Continuous Opioid Infusion

This technique can deliver adequate amounts of opioids, without the need for injections, through an intravenous or subcutaneous line inserted under general anaesthesia.

Continuous intravenous opioid infusions are used regularly in some hospitals after major surgery. However, assiduous respiratory monitoring is essential (see page 11, 15).
Local Anaesthetic Techniques

Minor or intermediate operations eg hernia repairs and circumcisions, are performed frequently in day-care units as children may be disturbed by prolonged hospital stay. Nausea, vomiting and sedation associated with the use of opioids may make discharge home on the same day of surgery undesirable. Techniques of "single shot" local anaesthesia are suitable for these patients, as well as those staying in hospital overnight.

Wound Infiltration

The wound is infiltrated along its edge with local anaesthetic by the surgeon at the end of surgery. Analgesia comparable to that obtained by the more complex procedure of caudal injection has been reported [Fell et al., 1988].

Caudal Epidural Injection

This technique is performed by the anaesthetist after induction of anaesthesia. Local anaesthetic solution is injected into the epidural space at the base of the spine (caudal canal). Good early postoperative analgesia is obtained after a wide variety of procedures performed commonly on children eg hernia repair, circumcision and orchidopexy.

Urinary retention and persistent numbness, or even weakness of the lower limbs, may occur temporarily and may necessitate overnight stay in hospital. Inadvertent intravenous or subarachnoid injection may occur (see page 21).

Nerve Blocks

These can be of considerable use in paediatric practice as they are simple to perform and relatively free from side-effects. The ilioinguinal nerve block is used frequently for hernia repair and orchidopexy. It is simple, effective and provides early analgesia comparable to that produced by a caudal injection. Furthermore, it is relatively free from the major complications associated with caudal blocks.

The dorsal nerve block of the penis is effective in children and is performed whilst the child is under anaesthesia. Analgesia is comparable to that produced by a caudal block without problems of lower limb weakness or urinary retention.

Femoral and sciatic nerve blocks are in some ways easier to perform in children and these have been used successfully to provide analgesia after lower limb surgery.

Patient-Controlled Analgesia

Several practitioners, especially in the USA, have reported success in older children using this technique. However, more research is needed to ascertain its safety and efficacy in paediatric practice.

Other Techniques

Local anaesthetic cream can provide good analgesia during the insertion of needles into the skin before and after surgery.

Lumbar and thoracic epidural techniques are used in children after major surgery but are confined largely to specialist centres. Their efficacy and complications are similar to those seen in adults.

Rectal administration of analgesics, especially paracetamol, is used more frequently in children. Rectal diclofenac has provided moderate analgesia in children after surgery but the place of NSAIDs in postoperative pain relief in children is not yet established.
Transdermal administration of opioids has obvious attractions but more research is required in adults before its use can be investigated in children.

5. Patients under the care of the Acute Pain Service are visited and examined regularly by members of the team.

6. Consultation notes are filed in the local office of the Pain Clinic.

ADVANTAGES OF AN ACUTE PAIN SERVICE

The introduction of an Acute Pain Service usually leads to a reduction in the management of postoperative pain. Some of the reasons and recent trends in the management of acute pain are discussed below. Details of the introduction of an Acute Pain Service are given in the report entitled "The Management of Acute Pain." Summaries are on a roller printed with necessary details of the current status and future plans of the pain service. The following information is included in each of the summaries:

1. Introduction of an Acute Pain Service
2. Consultation notes into the file of each patient

ORGANIZATION OF AN ACUTE PAIN SERVICE

A report on the organization of an Acute Pain Service in a large hospital is available. The report describes the philosophy and organization of a multidisciplinary approach to the management of acute pain. It discusses the introduction of an Acute Pain Service, the consultation notes, and the future plans of the pain service. The following information is included in each of the summaries:

1. Introduction of an Acute Pain Service
2. Consultation notes into the file of each patient

STARTING POINTS

Limitations of current knowledge and the need for comprehensive pain management in acute illness are discussed. The role of the Acute Pain Service in acute pain management is highlighted. The importance of education and training in the management of acute pain is emphasized.
ACUTE PAIN SERVICES

WHY DO WE NEED AN ACUTE PAIN SERVICE?

For a number of reasons the relief of acute pain, especially postoperative pain, is often less than optimal. In the UK, the adoption of techniques such as PCA and epidural opioid analgesia (EOA) has been tempered by fears of severe respiratory depression and the lack of an identifiable individual or group with responsibility for the relief of acute pain. This situation has been compounded by a general lack of understanding of the pharmacology and pharmacokinetics of opioids. In addition, there has been a failure to appreciate the potential risks of conventional intramuscular analgesia and psychological and physiological consequences of inadequate analgesia.

These problems have been addressed by the development of the Acute Pain Service (APS) as described by Ready in 1988.

ROLE OF AN ACUTE PAIN SERVICE

The aims of an Acute Pain Service can be summarised:

1. Responsibility for the day-to-day management of acute pain after surgery.
2. Organisation of services so that the level of care and monitoring is appropriate both for the clinical condition of the patient and the technique employed.
3. Provision of in-service training for medical and nursing staff involved in the management of postoperative pain. This should include establishment of programmes for the diagnosis and management of the complications and hazards of particular forms of treatment.
4. Audit of the beneficial and detrimental outcomes of existing methods of treatment and evaluation of new techniques.
5. Clinical research into the relief of acute pain.

ORGANISATION OF AN ACUTE PAIN SERVICE.

Experience both in the USA and UK has demonstrated that a multidisciplinary approach utilising medical, nursing, psychological and pharmaceutical expertise is essential to the successful provision of Acute Pain Services.

Anaesthetists have a primary role to play because of their familiarity with the drugs, equipment and regional techniques employed together with their expertise in non-invasive respiratory monitoring and the problems of airway management.

The nurse on the ward has traditionally played the major role in the relief of postoperative pain and this should continue to be the case. However, the advent of techniques such as PCA and EOA merits reappraisal of the role and responsibilities of the ward nurse. The appointment of a specialist nurse and/or clinical pharmacist in acute pain with responsibility for in-service training facilitates the safe introduction of new techniques. The incidence of equipment operator error falls with adequate in-service training.

STAFFING LEVELS

Limitation of resources does not preclude the establishment of an acute pain service. In some hospitals, the service has been developed from the existing obstetric anaesthetic personnel. Twenty-four hour anaesthetic cover, an aseptic dispensing service and adequate monitoring equipment are essential.
SELECTION AND PROVISION OF SERVICE

1. Patients suitable for management by the Acute Pain Service are selected by the anaesthetist during the preoperative visit and informed consent is obtained.
2. If PCA is selected, the patient is counselled on the use of the technique by a member of the team.
3. Treatment is initiated by the anaesthetist in the Recovery Ward immediately after surgery.
4. Each patient leaves the Recovery Ward with an individualised acute pain chart detailing subsequent frequency of nursing observations, any further medication and from whom advice may be obtained if necessary. This chart should contain sufficient details to enable subsequent clinical audit.
5. Patients under the care of the Acute Pain Service are visited and assessed regularly by members of the team.

ADVANTAGES OF AN ACUTE PAIN SERVICE

The introduction of an Acute Pain Service usually leads to a change in the attitude of all groups of staff to the management of postoperative pain. Audit of the results and feedback to the members of the Anaesthetic Department and other interested groups can result in a consistent approach to the management of these patients. Surgeons will often refer patients with unsatisfactory intramuscular analgesia to the Service. The development of a structured programme with readily available advice and assistance is appreciated by nursing staff on the ward as an improvement on previous ad hoc arrangements.
SAFETY AND MONITORING IN PAIN RELIEF: WHERE SHOULD PATIENTS BE NURSED?

The major fear with opioids administered by any route is that of respiratory depression. The traditional view is that this complication is characterised by a slow respiratory rate which can be detected by the intermittent observation of the patient by the ward nurse. Based on these observations, it is generally assumed that whilst intramuscular analgesia may not be totally effective, it is safer than newer forms of pain relief such as PCA or epidural opioid analgesia which may be associated with severe or delayed respiratory depression. However, the development of continuous respiratory monitoring such as pulse oximetry has revealed that episodes of hypoxaemia, secondary to loss of upper airway control, may occur in the presence of a normal respiratory rate with any form of administration of opioid analgesia. Furthermore, respiratory depression is not the only risk facing the postoperative patient. Poor analgesia may be associated with an increased likelihood of myocardial events in the postoperative period.

How do we define adequate monitoring of patients receiving newer forms of pain relief and where should these patients be nursed?

All patients recovering from major surgery should be nursed in an area with a high ratio of nursing staff to patients and the availability for continuous monitoring for many reasons, including the provision of adequate postoperative pain relief. These criteria are currently met on a High-Dependency Unit (HDU). However, in view of the fact that only 27% of hospitals in the UK have HDUs, limitation of techniques such as PCA and epidural opioid analgesia to such units would severely limit their use. Furthermore, even in those hospitals with HDUs, the small number of beds available would result in the application of these techniques only to high-risk patients, so that they would not reach the majority of patients undergoing major surgery.

In practice, any ward designated for the care of patients recovering from major surgery should have enough trained nurses and doctors to care for patients requiring intramuscular analgesia, PCA or epidural analgesia, subject to the following provisions:

1. The establishment of an Acute Pain Service with named consultants responsible for the provision of postoperative pain relief.
2. Rapid 24-hour availability of designated doctors and resuscitation team.
3. A system for monitoring patients on a regular basis including pain scores, respiratory rate and sedation scores (an increasing level of sedation may be the earliest sign of impending respiratory depression).
4. Protocols and an education programme for all staff for the detection and management of major complications.
5. Availability of continuous monitoring or transfer to an HDU or intensive-care unit for high risk cases.

If resources are made available to provide this level of care on general wards, techniques such as PCA and epidural opioid analgesia should not need to be restricted to HDUs.

It is the responsibility of the Acute Pain Service or designated consultant to organise services so that the level of care and monitoring is appropriate for the clinical condition of the patient and the technique of pain relief employed.
THE HIGH DEPENDENCY UNIT: HAS IT A SPECIAL ROLE IN PAIN RELIEF?

As the name implies, High Dependency Units have developed for the care of patients who need more observation and care than is generally available on ordinary hospital wards. They are a logical development of the concept of progressive patient care which recognises that the needs of patients vary during the course of an illness and its treatment. They are also a recognition of the need for equipment and skills to be concentrated to maximise their benefits.

High Dependency Units have a useful role in postoperative pain relief. Firstly, those patients with pre-existing impairment of vital functions, who undergo surgery which may be of a simple and straightforward nature, will need close observation during the administration of pain relieving measures.

Secondly, patients undergoing major procedures are more likely to experience severe postoperative pain, and also need to be closely observed in order to detect early signs of postoperative complications.

However, in regard to the generality of postoperative pain relief, it is probably more rational simply to identify the detailed requirements for safe implementation of particular techniques. For example, the level of monitoring by doctors and nurses which is necessary for patient controlled analgesia and epidural infusions should be decided. Depending on the assessed need, a given hospital may then decide to concentrate its resources of equipment and skills for the safe implementation of these techniques within a designated area.

There is a need for any acute hospital providing major surgery for high risk patients to have fully staffed and equipped High Dependency Units, where postoperative pain relief can be safely achieved (Crosby et al, 1990). However, for the larger number of patients undergoing "straightforward" surgical procedures, appropriately staffed postoperative wards and recovery areas should be designated, where adequate postoperative pain relief can be properly achieved.
EXTENDING THE ROLE OF THE NURSE

In order to meet the needs of patients, nurses are likely to be asked to extend their role with new methods of pain relief to include activities previously undertaken by doctors. The Health Circular (77)22 and subsequent document PL/CMO(89)7 and PL/CNO(89)10 provide guidance on this issue.

Activities that are appropriate for delegation by doctors to nurses in a particular care setting and speciality can be agreed by the medical and nursing professions locally. This extension would happen only within the context of a policy that the employing authority had approved. The initiative for establishing a policy should be taken in the ward or clinical department by the professional staff concerned. The nurse involved in extending her role must be "specifically and adequately trained for the delegated activity and be competent and willing to perform it."

Provisions need to be made at local level to enable nursing staff to develop this aspect of their work with in these guidelines.

THE ROLE OF THE HOSPITAL PHARMACEUTICAL SERVICE

The main objectives of the hospital pharmaceutical service are to:

1. Ensure preparation and assembly of medicines of the required quality.
2. Ensure economical and efficient procurement and supply of medicines.
3. Ensure safe and secure storage and distribution of medicines.
4. Facilitate safe, effective and economic use of medicines.

Methods of pain relief after surgery described in this report involve the administration to patients of a variety of drugs in both traditional and innovative dosage forms, via accepted and novel delivery systems. Preparation, assembly, procurement and supply of all medicines should be in accordance with the Medicines Act and standard pharmaceutical professional documents. A senior pharmacist must be responsible for organising, monitoring and reporting on a system for the safe and secure handling of drugs used for postoperative analgesia as described in the Duthie report [1986].

The preparation of parenteral drugs warrants special consideration. In the last few years, there has been an increase in the number of drugs administered by the intravenous route. This has resulted in nursing staff with the extended intravenous administration role training, being asked to prepare and administer more and more intravenous doses. In many hospitals for reasons of increasing work load, concerns about quality, and effective resource management, central intravenous additive (CIVA) services have been introduced. A CIVA service is one provided by the hospital pharmacy department which prepares and manipulates all forms of intravenous products under the correct aseptic environment and professional supervision, providing products which are ready to use. This service will play a vital role in the management of postoperative pain and the availability of such preparations on a 24-hour basis is essential.

The pharmacist should play a key role in the therapeutic management of postoperative pain and should be an active member of the hospital acute pain team.
WHAT RESEARCH INITIATIVES ARE NEEDED?

NEW ANALGESICS

The development of a drug as efficacious as morphine and without serious side-effects, in particular respiratory depression, is awaited. Although research continues, there is no prospect of such a drug in the near future.

NEW LOCAL ANAESTHETICS

The toxicity and relatively short duration of action of the available local anaesthetics limit their use for postoperative analgesia significantly. A safe local anaesthetic with a duration of action measured in days would make a considerable contribution to the management of pain after surgery. Ideally, an agent which would reverse the action of long-acting local anaesthetics should be available also.

MONITORING

The complications associated with techniques for pain relief after surgery have been investigated by research workers using complicated and expensive monitoring equipment. This is particularly so in the investigation of respiratory depression. There is a need for a simple inexpensive monitor which can be applied to all patients after surgery which would warn staff of the early physiological changes associated with respiratory depression.

Pulse oximeters are available generally and go a long way to reach this ideal. They measure arterial haemoglobin oxygen saturation using a probe attached to the patient's finger or toe. However, they are expensive and do not measure important parameters such as respiratory rate, minute volume and arterial carbon dioxide partial pressure.

SAFETY AND EFFICACY OF NEW METHODS

Many new methods for treating pain after surgery have been described in this report. There is a clear need for further research to establish the safety and efficacy of these techniques.

AUDITING TECHNIQUES

Pain Assessment in Clinical Situations

There is a need to implement an accurate and simple technique for the recording pain suffered by patients after surgery which can be analysed and audited subsequently.

Evaluation of Pain Teaching Programmes

Both Sofaei [1985] and Pilowsky [1988] have put forward ideas for an educational programme or curriculum on pain. Sofaei devised a ward-based educational programme, including students and trained staff, which resulted in significant improvements in patient outcome after surgery in terms of pain intensity and duration.
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REFERENCES


