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Analgesia in intensive care: part 2

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Key points

- Pain is a common problem in intensive care; regional anaesthesia (RA), although less studied, offers excellent pain relief while avoiding opioid-induced side-effects.
- Performance of RA in intensive care is fraught with challenges. The pharmacology of local anaesthetics (LAs) is greatly influenced by pathophysiological states common in this setting, and understanding this is important in minimizing the complications.
- Despite numerous dilemmas like sepsis, coagulopathy, inotrope dependence, and sedation, risk–benefits of RA have to be considered on an individual basis and the reasons clearly documented.
- In intensive care, a high index of suspicion and close monitoring is necessary to promptly identify the development of neuraxial infections or LA toxicity.
- The risk due to RA can be minimized by adopting local and national guidelines, using modern technologies, and considering available alternatives and local expertise.

Pain is a common cause of distress in the intensive care unit (ICU) and a vast majority of patients experience it at some point during their stay. Systemic analgesia, most notably opioids, remains the mainstay in its management. However, opioids are associated with significant side-effects like delirium, ileus, respiratory depression, and increased duration of mechanical ventilation, especially when used as continuous prolonged infusions.[1] There has been a general trend in ICU to move towards targeted analgesia and avoidance of sedation.

In the ICU, regional anaesthesia (RA) when indicated has the potential to offer excellent pain relief but avoiding the unwanted side-effects of opioids. Unlike the perioperative setting, its role in the ICU has not been thoroughly evaluated. However, the potential benefits offered by RA can be significant and extend beyond just provision of analgesia (Table 1). Despite its numerous advantages, RA remains an underutilized modality, due to various challenges and perceived disadvantages (Table 1).

The objective of this article is to provide an overview of the use of RA in the ICU: to discuss the advantages and disadvantages, to debate the commonly faced dilemmas, and to highlight the specific circumstances where RA may be beneficial. It is beyond the scope of the article to cover individual RA techniques.

Specific challenges in intensive care

RA in the ICU setting poses unique challenges, which can be divided into:

- drug factors;
- patient factors;
- human and environmental factors.

Drug factors

Pharmacology of local anaesthetics

The pharmacokinetics and pharmacodynamics of the local anaesthetics (LAs) may be altered due to the derangements in physiological and metabolic parameters commonly seen in ICU patients. Derangements in acid–base balance, hypoalbuminaemia, and organ failure (hepatic and renal) influence the ionization, unbound free fraction, and distribution of the LAs between body fluid compartments and their clearance. The impact of these derangements may be subtle like prolonged onset and

Table 1 Advantages and disadvantages of RA in intensive care

Advantages	Disadvantages
1. Excellent pain relief	1. Need for expertise and high-resolution ultrasound machines
2. Reduction in stress response	2. Variable failure rate
3. Reduction in use of opioids and their side-effects	3. Difficulty in obtaining consent
4. Reduced sedation, delirium, and ileus	4. Possible, but unproven higher incidence of rare and serious complications (e.g. epidural haematoma)
5. Ability to better assess neurology in the absence of opioids (especially polytrauma)	5. Difficulty in monitoring for side-effects in sedated patients (e.g. nerve injury)
6. Possible reduced duration of mechanical ventilation and early ambulation	6. Repeated position change leading to dislodgement and disconnection
7. Minimizes progression to chronic pain (e.g. in amputations)	7. Potential for errors—route and drug
8. Promotes gut motility and splanchnic perfusion	
9. Reduces sympathetic tone, useful in promoting blood flow in critical ischaemia	

duration of action or dramatic like LA toxicity. To factor these, adjustments to the choice and dose of LA may be needed.

The degree of ionization of an LA depends on the difference between its dissociation constant (pKa) and the pH in the tissues. As LAs are weak bases and have a pKa higher than the physiological pH, they exist predominantly in the ionized form in an acidic environment. As only the unionized form is lipid-soluble and hence can cross the cell membrane freely, onset of action will be delayed in both local (e.g. abscess) and systemic (e.g. septic shock, renal failure) acidosis. Hypoalbuminaemia, which is commonly found in acutely ill patients, increases the unbound free fraction of the LA, and can increase the risk of LA toxicity.

LA toxicity

Impaired ability to clear LA due to factors discussed above predisposes to LA toxicity, especially when administered in large doses or as prolonged infusions. Cardiovascular collapse or seizures may be the only sign, especially in sedated patients, and hence a high index of suspicion is necessary. The British National Formulary (BNF) recommends a maximum bupivacaine dose of 2 mg kg^{-1} over a 4 h period and 400 mg over 24 h. For ropivacaine, depending on the site of injection, the maximum recommended bolus dose varies between 200 and 300 mg and when used as an epidural infusion can be given up to a maximum of 28 mg h^{-1} (cumulative dose of 675 mg over 24 h).[2] The maximum allowable LA dose should be calculated on the basis of ideal body weight, with adjustments for organ impairment.

The use of adjuvants (opioids, clonidine, ketamine, epinephrine, and dexamethasone) allows for a reduction in the dose of LA, and in the case of epinephrine also reduces the plasma concentration. Every unit should have a protocol for management of LA toxicity and use of Intralipid® rescue as suggested by the Association of Anaesthetists of Great Britain and Ireland (AAGBI) guidelines.

Spread of LA

Spread of LA in the epidural or intrathecal space is influenced by changes in position, changes in intrathoracic pressure such as in intermittent positive pressure ventilation (IPPV) and the LA volume. In a study by Visser and colleagues,[3] after a test dose with 4 ml of 2% lidocaine through a low thoracic epidural catheter, application of 7.5 cm H_2O of CPAP resulted in a greater segmental spread of sensory blockade when compared with spontaneously breathing patients. The median increase in the spread was four segments, but this increase was predominantly found caudad to the injection site.

Patient factors

There are insufficient data on the incidence of complications due to RA in ICU and whether it is higher than the perioperative population. However, complications are more difficult to diagnose due to factors commonly found in ICU patients like use of sedation and the presence of abnormal neurology. In addition, peripheral oedema can obscure landmarks and result in poor ultrasound images; neuromuscular weakness can mask motor responses to nerve stimulation.

Owing to these challenges, it is reasonable to assume that RA techniques may run a higher risk of complications like failure, infection, bleeding, neuronal injury, pneumothorax, and haemodynamic compromise. In addition, the development of a complication is likely to have a greater impact on the recovery and rehabilitation of the patient, prolonging their length of ICU stay (LOIS). As an example, diaphragmatic paresis from interscalene block in a patient with chronic obstructive pulmonary disease may hamper successful weaning from ventilatory support. Immunosuppression is very common in ICU either due to pathological insults or pharmacological interventions (sepsis, steroids, drug-induced side-effects, etc.). This not only increases the risk, but may also mask the typical signs and symptoms of neuraxial infections. A high index of suspicion and regular monitoring for rare complications of RA (e.g. meningitis, vertebral abscess, epidural/subdural haematomas, and LA toxicity) is required. Daily nursing observations should include monitoring of neurological function and checking the catheter insertion site for signs of infection.

Organ dysfunction

Renal failure and uraemia can result in hyperdynamic circulation, resulting in rapid absorption and higher peak plasma concentration. This combined with lower plasma clearance of LA may lead to sustained high plasma concentrations. Hence, a 10–20% dose reduction relative to the degree of renal dysfunction is recommended in situations where a high bolus dose [e.g. brachial plexus, paravertebral blocks (PVB)] or prolonged continuous infusion techniques or where repeated boluses/blocks (<5 half-lives) are needed.[4]

In hepatic dysfunction, marked derangements in physiology can occur, including coagulopathy, increased volume of distribution, reduced plasma clearance, hyperdynamic circulation, and concomitant renal dysfunction. Usually, LA doses need not be decreased for single-shot techniques. However, doses need to be reduced by 10–50% for continuous infusion or repeated boluses/blocks (<5 half-lives) depending on the extent of the hepatic and renal dysfunction.[4]

In cardiac failure, the low cardiac output state results in a reduction in the hepatic and renal clearance of drugs. As a consequence, LAs with high first-pass metabolism (e.g. lidocaine) may reach a high plasma concentration. In contrast, strongly protein-bound drugs like ropivacane and bupivacaine have a relatively low first-pass metabolism and hence are not greatly affected. In the presence of advanced heart failure, dose reduction to the order of 10–20% is recommended. Also, epinephrine should be avoided as an additive to LA in these patients due to the risk of arrhythmias.[4]

Human and environmental factors

Infrequent use of RA in ICU results in lack of opportunities for training and familiarity among the nursing staff, and increases the risk of human errors. Using non-interchangeable connectors in RA reduces the chances for drug errors or LA toxicity from inadvertent i.v. infusion.

There is an increased risk of catheter dislodgement due to repeated changes in position for routine aspects of ICU care and to aid oxygenation. Tunnelling catheters intended for longer use and securing the connectors firmly with specialized devices could mitigate this risk. Other environmental factors like space constraints (e.g. indwelling drains, lines and tubes, ICU equipments) and availability of necessary RA equipment can also be an impediment.

Indications for RA

The indications for performing RA in ICU are similar to the perioperative period and in many cases is only a continuum. For example, thoracic epidural analgesia (TEA) facilitates early weaning from ventilatory support in lung surgery, lung transplant, and thoracic trauma.[5] The medical and surgical conditions, which are specific to ICU, which benefit from RA are summarized in Table 2.

RA in ICU: controversies

There are many clinical dilemmas, which clinicians often face when deciding to perform RA in ICU. In a survey of ICUs in the Northwest critical care network, systemic sepsis and vasopressor therapy were cited as the most common contraindications for the performance of RA, followed by coagulopathy and sedation.[6]

It is impossible to provide specific guidance on the suitability of RA in these circumstances, but the generic recommendations in these areas of controversy are:

(i) To perform a risk–benefit analysis on an individual basis and clearly document the reasons. For continuous techniques, the risk–benefit analysis must be reviewed on a daily basis.
(ii) To minimize the risk of RA by:
- availing best local expertise;
- avoiding multiple needle passes;
- using advanced technology like ultrasound;
- appropriate case selection;
- consideration of available alternatives;
- meticulous monitoring for complications.

RA in a septic patient

Serious central neuraxial infections such as arachnoiditis, meningitis, and abscess after neuraxial anaesthesia are rare but can have catastrophic consequences. From the NAP 3 report,[7] the incidence of epidural abscess in the perioperative period after neuraxial instrumentation is approximately one in 47 000, the incidence of permanent harm from vertebral abscess is approximately one in 88 000, and the incidence of paraplegia is one in 236 000. The incidence of bacterial meningitis is <1:200 000.

These incidences are based on perioperative data and not specifically from patients with raised inflammatory markers, bacteraemia, or sepsis. Risk factors for neuraxial infections are

Table 2 Indications of RA in intensive care

Indications of RA	Regional anaesthetic options
Surgical indications	
Thoracotomy—lung transplant/lung resections	Thoracic epidural
	Paravertebral blocks
Laparotomy	Neuraxial-epidural/spinal
	TAP blocks: classical and subcostal approaches
	Rectus sheath blocks
	Local infiltration analgesia
Rib fractures	Thoracic epidural
	Paravertebral blocks
	Interpleural block
	Intercostal blocks
	Serratus plane blocks
Limb fractures (traumatic and pathological)/amputations	Lower limb: spinal/epidural
	Plexus (lumbar+sacral), fascial plane blocks (fascia iliaca blocks), and peripheral nerve blocks (femoral, sciatic, popliteal)
	Upperlimb: brachial plexus blocks and peripheral nerve blocks
Non-surgical indications	
Acute pancreatitis	Thoracic epidural; coeliac plexus block
Neuralgia, complex regional pain syndromes (CRPS) and ischaemic limb	Sympatholytic blocks
Procedures in ICU	
Chest drains	Intercostal blocks
Tracheostomy	Superficial cervical plexus block
Debridement/dressing changes	Upper and lower limb blocks as above

diabetes, immunosuppression, neuraxial trauma or instrumentation, and systemic or local infection. Despite the frequent presence of the above risk factors in the ICU population, there is not enough evidence to suggest that this poses an increased risk.

In neuraxial infections, bacterial seeding can be due to endogenous (haematogenous or local spread) or exogenous (staff and equipment) factors. Despite the lack of data, there is a general belief that neuraxial blocks must be avoided in patients with systemic sepsis, raised inflammatory markers, or both. Clinical cohort studies and retrospective reviews mainly in paediatric patients with bacteraemia report conflicting results.

There is a disconnect between the organisms that commonly cause systemic sepsis and those that are incriminated in neuraxial infections. Sepsis is not infrequently caused by gram-negative organisms, whereas the commonly isolated organism from a vertebral abscess is *Staphylococcus aureus*. In a prospective audit, catheter colonization was a very common occurrence with an incidence of 29%, but none of the patients with catheter colonization developed neuraxial infection.[8]

Neuraxial infections are medical emergencies, which require prompt diagnosis and urgent treatment to avoid permanent disability. The classical clinical features of meningitis (headache, confusion, neck stiffness, and photophobia) and vertebral abscess (back pain, temperature, neurological deficit in the lower limbs, and raised inflammatory markers) are very inconsistent findings. Neuromuscular block, sedation, confusion and delirium, inability to communicate, raised temperature, and inflammatory markers due to other infections, pre-existing antibiotic therapy, and bacteriostatic effects of LA infusions are some of the confounding factors that could mask the presentation of neuraxial infections; hence, a high index of suspicion is necessary for early intervention and a favourable outcome.

Recommendations for performing neuraxial blocks in the presence of sepsis are (adapted from Wedel and Horlocker):[9]

(i) Except in the most extraordinary circumstances, central neuraxial block should not be performed in patients with untreated systemic infection.
(ii) Patients with evidence of systemic infection may safely undergo spinal anaesthesia, provided appropriate antibiotic therapy is initiated before dural puncture and the patient has shown a response to therapy, such as a decrease in fever (placement of an indwelling epidural catheter in this group of patients remains controversial).
(iii) Epidural catheters should be removed in the presence of local erythema, discharge, or both; there are no convincing data to suggest that concomitant infection at remote sites or the absence of antibiotic therapy are risk factors for infection.
(iv) Close monitoring of neurology and signs of local infection at the injection site may help in early diagnosis, especially when epidural catheters are *in situ* for >48 h. A delay in diagnosis and treatment of major central nervous system infections of even a few hours may significantly worsen neurological outcome.

There is no guidance available for performance of peripheral nerve blocks (PNBs) (single shot or continuous) in the presence of systemic sepsis. It would be safe to assume that the risks may be less than that posed by neuraxial techniques.

Vasopressor therapy

Neuraxial anaesthesia commonly produces hypotension and bradycardia due to sympathetic block and requires administration of vasopressors. In ICU, neuraxial analgesia aggravates hypotension in patients with reduced venous return (e.g. hypovolaemia, IPPV). Avoidance of LA boluses, use of continuous infusions, dilute concentrations of LA, and inclusion of additives may mitigate some of the haemodynamic effects. Alternative RA techniques with fewer propensities to cause haemodynamic instability should be considered. For example, in patients undergoing laparotomy, rectus sheath catheters, when compared with epidural analgesia (EA), have been shown to be equally efficacious, while decreasing the need for vasopressors or fluid therapy.[10]

There are no contraindications for PNB in patients on pre-existing vasopressor therapy, although theoretically, the risk of nerve injury can be higher due to constriction of the vasa-nervorum and alteration of the microcirculation.

Haemostatic abnormalities

Coagulation and platelet abnormalities are common in the intensive care setting: thrombocytopenia (platelets $<100\times10^{-9}$ litre^{-1}) occurs in 35–41% of surgical patients in ICU and coagulation abnormalities can occur in 14–18% of ICU patients. The commonly encountered disease pathologies in the ICU that result in abnormal haemostasis are sepsis, polytrauma and massive transfusion, disseminated intravascular coagulation, liver failure, and uraemia. In addition to this, pharmacological anti-coagulation is almost universally used in ICU due to the risk of deep venous thrombosis, atrial fibrillation, myocardial infarction, and hypercoagulable states due to malignancy. Both acquired and iatrogenic derangements of coagulation may influence the use of RA in ICU. Hence, a careful assessment on the presence of coagulation abnormalities and a review of the prescription chart must be diligently performed.

There is no specific guidance for RA in ICU in the presence of pathological haemostatic derangements; however, the generic guidance published by the American Society of Regional Anaesthesia (ASRA) and AAGBI[11] can be used for decision-making. Haemostatic abnormalities are a relative contraindication to the performance of neuraxial and PNBs. The risk is not the same for all RA blocks: proximal, deep, and perivascular blocks are at higher risk compared with distal, superficial, or 'plane' blocks and it is helpful to refer to the AAGBI stratification of relative risk due to various RA techniques (Fig. 1). The current thinking is, deeper blocks should share the same stringent criteria as the neuraxial blocks on acceptable haemostatic parameters. The advent of ultrasound to perform RA blocks widens the margin of safety in expert hands, and can reduce the risk for some of the deeper and perivascular blocks compared with landmark techniques.

The factors to consider in the risk–benefit analysis include: haemostatic pathology, extent and rapidity of progression of haemostatic derangement, the feasibility for correction of the haemostatic abnormality, the proposed RA block, and its available alternatives.

Haematological abnormalities may develop newly or the existing abnormality may worsen when a continuous RA catheter is still *in situ*. Criteria for catheter removal are exactly the same as catheter insertion, and in the presence of abnormal haemostasis, correction of the abnormality should be aimed for, with haematologist's advice.

Unconscious and sedated patients

RA in the ICU poses two unique challenges, consent and the risk of complications in sedated/anaesthetized patients. Of the two,

	Block category	Examples of blocks in category
Higher risk	Epidural with catheter Single-shot epidural Spinal	
	Paravertebral blocks	Paravertebral block Lumbar plexus block Lumbar sympathectomy Deep cervical plexus block
	Deep blocks	Coeliac plexus block Stellate ganglion block Proximal sciatic block (Labat, Raj, sub-gluteal) Obturator block Infraclavicular brachial plexus block Vertical infraclavicular block Supraclavicular brachial plexus block
	Superficial perivascular blocks	Popliteal sciatic block Femoral nerve block Intercostal nerve blocks Interscalene brachial plexus block Axillary brachial plexus block
	Fascial blocks	Ilio-inguinal block Ilio-hypogastric block Transversus abdominis plane block Fascia lata block
	Superficial blocks	Forearm nerve blocks Saphenous nerve block at the knee Nerve blocks at the ankle Superficial cervical plexus block Wrist block Digital nerve block Bier's block
Normal risk	Local infiltration	

Fig 1 Relative risk of RA in patients with haemostatic abnormality (reproduced with kind permission from the Association of Anaesthetists of Great Britain and Ireland).[11]

the issue of consent is much clearer. Numerous procedures that are performed in a sedated patient in ICU (e.g. tracheostomy and invasive vascular access) are performed keeping the best interests of the patient in mind, carefully weighing the benefits and risks of the procedure to be performed. Consent for RA in ICU is no different from these other procedures, and should be considered if the benefits outweigh the risks.

Many anaesthetists prefer to perform RA in awake patients and would not perform it in anaesthetized patients. However, there is no evidence of increased risk of complications when RA is performed under anaesthesia and it is the only option in paediatric patients. Similarly, the ICU environment does not give one the luxury of performing the blocks awake. Despite the lack of evidence, utmost care must be taken when performing RA in the ICU and monitoring for complications.

Trauma and compartment syndromes

Severe pain and paresthesia are the main symptoms of an evolving compartment syndrome (CS). The incidence of complications and poor outcomes increases with the increasing time from diagnosis to fasciotomy. Complications include muscle necrosis, neurological deficit, rhabdomyolysis, acute kidney injury, amputation, and not infrequently death. In ICU, these symptoms may be masked in head-injured or sedated patients and difficulties in sedation or pain management may be the only clue for an ongoing progression of CS. Under these circumstances, compartment perfusion pressures (diastolic pressure minus compartment pressure) and absolute compartment pressures should be used to diagnose CS, although there are no universally agreed cut-off thresholds.

The clinical symptoms and signs of CS are often variable and unreliable with a very high false-positive rate. Pain is an inconsistent symptom; patients can have CS with no pain or severe pain. Even though all analgesic modalities (PCA, nerve blocks, and EA) have been implicated in the delayed diagnosis of CS, it could easily be averted if patients have regular monitoring of pain, sensation, movement, and function.[12] Despite a commonly held belief that RA should be avoided in situations where there is a risk of developing CS, there are no randomized controlled trials evaluating the influence of RA on delaying its diagnosis and the evidence is limited to case reports and case series. Many experts believe that EA does not contribute to delayed diagnosis of CS. In the published review by Mar and colleagues,[12] >90% of the patients still demonstrated classical signs and symptoms of CS, in the presence of EA. Fifty-one per cent of patients had breakthrough pain and delays in diagnosis occurred only when the motor blocks were dense.[13] Of the PNBs, there is no evidence that they delay diagnosis of CS in the upper limbs and thigh CS (femoral block) in lower limbs. Traumatic mid-shaft tibial fractures were most commonly missed in the presence of PNB.

A high concentration LA infusion can mask many of the symptoms of CS, by causing complete limb anaesthesia and paralysis. Hence, avoiding dense blocks by using weak concentrations of LA with adjuncts like opioids and using continuous infusions aid good pain management and facilitate early diagnosis. Providing suboptimal analgesia for identification of CS is a bad practice, and in most cases, breakthrough pain or increasing analgesic requirements precedes the development of clinical signs. Triaging high-risk patients, a high index of suspicion and regular clinical monitoring with early measurement of compartmental pressures form the cornerstones in the early diagnosis and management of CS.

Analgesia in intensive care: specific situations

Rib fractures

The prevalence of rib fractures is 4–10% among the trauma population, with mortality ranging from 3% to 13%, pulmonary complications from 16% to 60%, and they account for up to 25% of the trauma-related fatalities. The mortality and pulmonary complications increase with age, pre-existing conditions, number of ribs fractured, presence of flail segments, and lung injury.

Development of pulmonary complications (pneumonia, atelectasis) determines the duration of mechanical ventilation, LOIS, and length of hospital stay (LOHS) and severe pain is a contributory factor in development of this associated morbidity.

Effective analgesia is able to reverse some of the pulmonary complications. Both systemic (oral, i.v. opioids and PCA) and regional analgesia (epidural, paravertebral, interpleural, intercostal blocks) can be used.

There is ongoing debate about systemic or TEA on mortality, LOIS, and LOHS in patients with rib fractures. In patients with three or more rib fractures, Gage and colleagues[14] reported a reduction in the odds of death for up to a year, in those receiving TEA when compared with systemic analgesia. In contrast, other reviews did not find a difference in mortality, LOHS, or duration of mechanical ventilation.[5,15] But none of these studies looked into significant adverse effects of opioids like delirium.

PVB provide good-quality sensory block of the hemithorax with reduced incidence of hypotension, motor block, and urinary retention that are common with TEA. Continuous PVB for unilateral rib fractures provides significant improvement in pain scores at rest and on coughing, improves peak expiratory flow rates and oxygenation. In patients with unilateral rib fractures, PVB provides equivalent analgesia when compared with TEA, with no difference in LOHS, LOIS, or pneumonia rates. PVBs are technically challenging to perform and carry a 1–2% risk of pneumothorax. Ultrasound guidance improves the success rate and minimizes the complications of PVB. In a retrospective audit in the author's centre (M.N.), continuous paravertebral analgesia provides effective pain relief and may be associated with fewer ICU admissions with respiratory failure (unpublished data).

Continuous intercostal nerve block has been shown in a prospective case series to significantly reduce the pain on rest and coughing and decrease the LOHS, whereas interpleural analgesia has not been shown to be of any benefit.

Based on the current evidence, it is not possible to recommend any single technique for pain management in patients with fractured ribs, which can be applied in all possible circumstances.

Laparotomy

Laparotomy is one of the most common surgical reasons for admission to ICU and until recently, only EA was the commonly used RA technique to provide pain relief. EA does not reduce mortality when compared with systemic opioids, but has a favourable influence on numerous morbidity factors: reduction in the incidence of paralytic ileus, delirium, LOIS, and duration of mechanical ventilation. EA, when compared with i.v. analgesia, increases functional residual capacity by 27% and decreases the rate of pulmonary complications,[16] which carries a greater significance in ICU. In the MASTER trial involving patients undergoing major abdominal and oesophageal surgeries, even though there was no difference in mortality rates, TEA was associated with significantly reduced pulmonary complications and lower pain scores, without an increase in catheter-related complications.[17] In a retrospective study, there was a 70% risk reduction in the TEA group for anastomotic leak after oesophagectomies.[18]

There are instances in ICU where EA is contraindicated or the side-effects undesirable (hypotension and bradycardia), where continuous trunk blocks [rectus sheath blocks, transversus abdominis plane (TAP) blocks, and wound infiltration catheters] are effective alternatives. They offer equivalent analgesia while reducing the need for rescue vasopressors, fluid therapy, and urinary catheterization.[10] EA has a high failure rate, more so in the ICU, and trunk blocks can be used as a rescue analgesic technique. Trunk blocks when compared with opioid-based techniques offer equivalent analgesia but with quicker recovery of bowel function.

It is important to understand the anatomy to choose the most appropriate technique for the patient. Rectus sheath blocks are effective in providing analgesia by blocking the anterior cutaneous nerves of the abdomen. They carry many advantages over EA—they can be sited either by the anaesthetist or by the surgeon, intraoperatively or after operation, and without the need for a change in position of the patient. Complications are rare, but one needs to be aware of the risk of rectus sheath haematoma, which can mimic an acute abdomen or sepsis by causing haemodynamic instability.

TAP blocks, unlike rectus sheath blocks, are effective for transverse incisions, but are inadequate for covering dermatomes above T10 level. A variant of TAP block, the subcostal oblique TAP block, can be used for incisions above the T10 dermatome, for example, 'roof-top' incisions for cholecystectomy and liver resections. In a retrospective study, TAP blocks were as effective as EA for open abdominal aortic aneurysm repair.

Acute pancreatitis

Acute pancreatitis is a very common surgical emergency with an annual incidence of 15–35 per 100 000 and with a mortality of up to 30% in severe types. It is associated with severe pain, and opioid-based strategies remain the mainstay of analgesia. However, opioids can cause or worsen ileus, sedation, and reduce respiratory drive, which may be detrimental to these patients, who generally present with multi-organ impairment.

There has been inertia for adopting TEA as a normal component of pain management in acute pancreatitis, even though there have been successful reports dating back to 1950. There is encouraging evidence derived from animal studies, that thoracic epidural block may play a vital role in modifying splanchnic tissue microperfusion, protecting vulnerable microcirculatory units from ischaemic damage and improving end-organ perfusion, regardless of its effects on macro-haemodynamics.[19] In a prospective study of 121 patients with acute pancreatitis, 72% obtained excellent analgesia with TEA without the need for other added analgesia; only 8% required vasopressor support, with no reported complications.[20] The optimal timing and the duration of TEA remain unclear. In another prospective case series, continuous coeliac plexus block provided effective pain relief in patients who failed to respond to TEA, especially with a history of alcohol or opioid dependence.

Vasospasm and sympathetically mediated pain

Stellate ganglion block has a unique role in providing analgesia for complex regional pain syndromes and refractory ischaemic chest pain, despite medical management. It provides sympatholysis and hence finds use in the salvage of ischaemic limbs in patients with peripheral vascular disease and in the treatment for vasopressor extravasation. It has also been shown to reduce the incidence of vasospasm of intracranial and extracranial arteries after subarachnoid haemorrhage or aneurysm coiling, resulting in improvement of GCS.[21] There are case reports of the usefulness of stellate ganglion block in the management of ventricular arrhythmias and sustained ventricular fibrillation refractory to electrical and pharmacological management.

Hip fractures

Annually, about 64 000 patients are admitted with hip fracture in the UK and the average 30 day mortality is around 8%. Achieving adequate analgesia in the population could be a challenge and conventional systemic analgesics like opioids carry significant adverse effects, as discussed above. RA techniques like fascia iliaca compartment block (FICB) and femoral nerve block can minimize or circumvent these adverse effects and provide superior quality of analgesia. In comparison with femoral nerve block, FICB being a 'plane block' is anatomically distant from the neurovascular structures and thereby minimizes the risk.

The benefits of these blocks extend beyond just provision of pain relief—they decrease the incidence of sedation and delirium, nausea and vomiting, need for supplemental oxygen, morphine requirements, and LOHS. Both the incidence and the duration of delirium are reduced in patients receiving FICB.

Conclusion

RA is an under-utilized modality, but has the potential to provide excellent pain relief while avoiding the side-effects of systemic drugs in intensive care. There are many common dilemmas faced while considering RA in the ICU, and risk–benefits have to be individualized. Risks can be minimized by following local and national guidelines, using modern equipment and techniques and maintaining expertise in RA.

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Declaration of interest

None declared.

MCQs

The associated MCQs (to support CME/CPD activity) can be accessed at https://access.oxfordjournals.org by subscribers to *BJA Education*.

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