Regional anaesthesia in the elderly

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There has been a dramatic rise in the elderly population with the number of people aged over 65 increasing three-fold in the last century. The age group that is growing most rapidly includes those aged 85 and over. Consequently this has led to a progressive increase in the number of surgical interventions in elderly people. It has been estimated that over half of the population aged over 65 years will require surgical intervention at least once during the remainder of their lives. Regional anaesthetic techniques (peripheral nerve blockade, central neuraxial blockade) are frequently used in elderly patients. This lecture will focus on the impact of age on the clinical and pharmacological aspects of epidural and spinal anaesthesia in particular, and will be accompanied by an additional discussion of certain aspects of peripheral nerve blockade.

Age-related changes relevant to regional anaesthesia

Both the central and peripheral nervous system degenerate with advancing age. These changes may have an impact on neural block characteristics and the pharmacology of local anaesthetic agents. A reduction in the number of neurones within the spinal cord, deterioration of myelin sheaths and connective tissue barriers, changes in the anatomical configuration of the lumbar and thoracic spine, possible reduction in the volume of cerebrospinal fluid and slowing of the conduction velocity in peripheral nerves, especially the motor nerves, all contribute to altered nerve block characteristics (dose-response relationship) following epidural and subarachnoid administration of local anaesthetic agents [1].

After lumbar epidural administration of a given dose (fixed volume and concentration) of a local anaesthetic solution the spinal level (height) of analgesia increases with advancing age [2-4] and, similarly, following thoracic epidural administration of a fixed dose [5]. This is due to progressive sclerotic closure of the intervertebral foramina. Epinephrine is used frequently as a part of a test dose to detect intravascular injection and elderly patients may have a reduced response because the beta-receptor affinity for adrenergic agonists is diminished [1].

With spinal anaesthesia the extent of the block depends on the baricity of the solution [1]. The effect of age on the maximal height of spinal analgesia with isobaric solutions is marginal, but with a hyperbaric solution a higher sensory block and a quicker onset time of motor block have been found in older patients.

Clinical problems

Epidural and spinal anaesthesia may present some problems in elderly patients. Performing epidural and spinal anaesthesia may be more difficult in elderly patients. It is often not easy to position the elderly patient appropriately because of the anatomical irregularities that may be found in many old people, particularly curvature or rotation of the spine. Additionally, the intervertebral foramina are narrowed by sclerotic changes and calcification in elderly patients. In advanced age with degenerative disc and joint changes, distortion and compression of the epidural space are typical. The structure of the ligamentum flavum probably changes into a form that is easily ossified. Increased epidural compliance and decreased epidural resistance, increased residual epidural pressure and progressive sclerotic closure of the intervertebral foramina with advancing age may all contribute to enhanced epidural spread of local anaesthetic solution in the elderly.
Hypotension, hypothermia and increased sensitivity to local anaesthetics are serious problems during regional anaesthesia in the elderly.

**Hypotension**

Hypotension during spinal and epidural anaesthesia results from sympathetic blockade that leads to vasodilatation and a reduction in systemic vascular resistance. With an extensive block this may lead to decreased venous return that is the main determinant of hypotension during central neuraxial blockade. Carpenter reported the incidence and risk factors for side-effects of spinal anaesthesia [6]. High levels of sensory anaesthesia and increasing age appeared to be the two main risk factors for the development of hypotension. High levels of analgesia were associated with bradycardia and hypotension in elderly patients undergoing epidural anaesthesia [3]. Decreased cardiac reserves, structural changes in the arterioles and changes in the autonomic nervous system with increasing age may also play a role. Marked hypotension may be especially harmful to elderly patients with limited cardiac reserve. Preloading with fluids, either crystalloids or colloids did not prevent hypotension after spinal anaesthesia in elderly patients [7]. A combination of fluids and vasopressors when given in the first 5-10 min (when the block is evolving) seems to be the most effective treatment for hypotension after spinal or epidural anaesthesia in elderly patients [8].

One of the most effective methods of preventing hypotension is to avoid a high sensory block. Continuous spinal anaesthesia allows the administration of small incremental doses of local anaesthetics and thus provides a more controllable sensory and sympathetic level. It is a very effective technique in providing haemodynamic stability in elderly patients undergoing lower extremity surgery [9]. The rationale for combining local anaesthetics with adjuvant drugs is to use lower doses of each agent and to sustain analgesia with fewer side-effects. A reduced dose of hyperbaric bupivacaine (7.5 mg) in combination with sufentanil [10] or a small dose of plain bupivacaine (4 mg) in combination with fentanyl (20 µg) provided reliable spinal anaesthesia for the repair of hip fracture in aged patients with few episodes of hypotension and little need for vasopressor support [11].

**Hypothermia**

Elderly patients who undergo spinal or epidural anaesthesia are at increased risk of hypothermia, because a low core temperature may not initiate autonomic protective responses. Advancing age and high-level spinal blockade are associated with a significant decrease of thermoregulatory threshold [12]. The shivering threshold is decreased in proportion to the level of spinal blockade because the vasomotor tone is inhibited below the level of spinal block and the greater the proportion of the body that is blocked, the greater the level of thermoregulatory dysfunction that can be expected.

**Sedation**

Geriatric patients show an increased sensitivity to benzodiazepine compounds [13]. Smaller doses and a longer period between increments must be used and caution should be used when benzodiazepines are given to geriatric patients as premedication. Elderly patients are more sensitive to the hypnotic and EEG effects of propofol than are younger persons. Propofol infusion for sedation during spinal anaesthesia resulted in a delayed recovery time in the elderly patients compared with younger patients [14]. Elderly patients may require a more prolonged observation period after sedation with propofol.

**Pharmacology**

**Pharmacokinetics of local anaesthetics**

Changes in body composition and characteristics of tissues and organs within the body may have an impact on the rate and extent of systemic absorption, distribution and elimination of local anaesthetics used for regional anaesthesia. Pharmacokinetic or pharmacodynamic changes, which occur with increasing age, may alter the clinical profile of local anaesthetics following a regional anaesthetic. Changes in the pharmacokinetics may, in part, be responsible for the observed changes in the clinical profile. Epidural absorption studies with bupivacaine, ropivacaine and levobupivacaine and a spinal absorption study with bupivacaine demonstrated an increased sensitivity in the elderly that does not appear to be related to the impairment of vascular absorption [1, 15]. Therefore, changes in the clinical
profile with epidural and spinal anaesthesia are best explained by anatomical considerations and possibly pharmacodynamic, rather than pharmacokinetic, changes in the elderly.

The plasma clearance of lidocaine, bupivacaine and ropivacaine decrease with increasing age [15]. Taking into account the age-related decreased clearance of lidocaine, bupivacaine and ropivacaine, the administration of multiple intermittent injections or continuous epidural infusion can lead to increased accumulation of these agents. Consequently, the potential of developing side-effects, including toxicity may be enhanced.

Effects of regional anaesthesia on outcome in elderly surgical patients

To demonstrate superiority of one anaesthetic technique above another requires a review of the outcome. The incidence of cardiovascular diseases is high in elderly surgical populations undergoing peripheral vascular surgery of the lower extremity. In this patient population studies have been performed comparing regional with general anaesthesia with respect to postoperative mortality and cardiac morbidity. However, no difference was found in the incidence of cardiac ischaemia in patients who were randomly assigned general, epidural or spinal anaesthesia combined with postoperative epidural analgesia or general anaesthesia with on-demand opioid analgesia (PCA) [16]. Postoperative outcomes were not influenced by the intra-operative and postoperative anaesthetic regimen. Thus, peri-operative care, rather than a specific anaesthetic regimen, may be the most important factor in determining outcome after major vascular surgery.

The early administration of continuous epidural analgesia was associated with a lower incidence of pre-operative adverse cardiac events in elderly patients with hip fracture who have, or are at risk of, coronary artery disease [17]. Although the study group was small, the results warrant further study of pre-operative analgesia in this population.

It appears that postoperative thoracic epidural analgesia is superior to lumbar epidural analgesia in reducing postoperative myocardial infarction [18]. This suggests that in high-risk cardiac patients, thoracic epidural postoperative analgesia is warranted and should be used more widely.

Many individual controlled studies comparing regional anaesthesia with general anaesthesia have lacked the statistical power to provide a conclusive answer as to which gives the better outcome in terms of morbidity and mortality. In addition most controlled trials have failed to demonstrate that either regional anaesthesia or general anaesthesia is clearly superior in terms of outcome in elderly patients. It seems that the probability of a serious respiratory or haemodynamic complication after surgery in elderly patients, as in young adults, is largely determined by the nature of the surgery and by the patient’s general state. Further large, well-designed RCTs are necessary to draw firm conclusions on the effect of anaesthetic techniques on long-term outcome after surgery in elderly patients. Further evaluation of the clinical and specific pharmacological aspects of regional anaesthetic procedures in older people is still required.

Postoperative cognitive function

Early postoperative cognitive dysfunction (POCD), confusion and delirium are common after major surgery in the elderly. Regional anaesthesia reduced the incidence of POCD in the first postoperative week [19]. However, no significant difference was found in the incidence of cognitive dysfunction three months after either general or regional anaesthesia in elderly patients.

Peripheral nerve blockade

Peripheral nerve blocks are frequently used in elderly patients as a satisfactory supplementary analgesic technique for upper limb trauma, hip and knee surgery. Few studies have been performed investigating peripheral nerve block characteristics in elderly patients. Sensory and motor blocks lasted approximately 2.5 times longer in the elderly compared with young patients after a brachial plexus block with ropivacaine [20], as well after a sciatic nerve blockade with mepivacaine [21]. Further studies are indicated to investigate the effect of age on the characteristics of other peripheral blocks. Combined, pharmacokinetic-pharmacodynamic studies will enable practitioners to predict the dose requirement of local anaesthetics for older patients more accurately.
Key learning points

• Older patients experience slightly higher spinal levels of sensory and motor blockade following epidural and spinal anaesthesia and are also at somewhat greater risk of hypotension. Thus, bolus doses of local anaesthetic should be reduced in elderly patients in order to limit side-effects.
• The duration of analgesia and motor blockade last longer in the elderly after peripheral nerve blocks.
• The clearance of bupivacaine, ropivacaine and lidocaine decrease with age. Consequently, infusion rates or top-up bolus doses may need to be adjusted.
• Regional anaesthesia has several beneficial effects for elderly patients, including reduced blood loss, better peripheral vascular circulation, suppression of the surgical stress response and better postoperative pain control.
• Most controlled trials have failed to demonstrate that either regional or general anaesthesia is clearly superior in terms of outcome in elderly patients.

References