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Overview

# Regional anaesthesia for the elderly patients

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## Abstract

*Elderly people require surgery four times more often than the rest of population. Anaesthesia related morbidity and mortality are higher in the elderly patients. Aging is a universal and progressive physiologic phenomenon characterized by degenerative changes. In geriatric patients there is reduction in the structure and the functional reserve of organs and tissues. To keep adequate organ persufion during anaesthesia is of the paramount importance. Regional anaesthesia appears to be safe in the elderly patients because it reduces stress response, the incidence of thromboembolic complications and provides good postoperative analgesia.*

## INTRODUCTION

Elderly population with its associated health concerns is expanding rapidly. The prevalence of cardiovascular disease increases with age. Many geriatric surgeries are performed as a result of increasing longevity. Elderly people require surgery four times more often than the rest of the population *(1)*. It is estimated that number of patients undergoing surgery will increase by 25 % by 2020, and for the same time period the elderly population will increase by > 50 % *(2)*. Anaesthesia related morbidity and mortality remain higher among elderly than among young adult surgical patients.

It is important that anaesthesiologist plays a significant role in management of elderly patients. Pre-operative evaluaton requires multidisciplinary approach from anaesthesiologist, cardiologist, internist, surgeon, primary physician,physiotherapists, nurses… Their advice and contribution may improve the outcome of surgery and future quality of life for the elderly patient. The goal of the consultation is the optimal care of the patient. A decision whether to operate should be made at a consultant level, ideally in conjunction with the multidiscplinary approach, family and most important the patient.

### Pre-operative assessment

A careful pre-operative assessment is imperative to achieve a good outcome. Prior to taking a history, a mini mental state score is very useful primarily to assess reliability of information but secondarily it might prove very useful in the postoperative period. Appropriately trained stuff using formal tests of cognitive function should only diagnose confusional states. Assessment of co-existing medical problems is of paramount importance. The potential list is very long and includes ischaemic heart disease, hypertension, chronic obstructive pulmonary disease, stroke, arthritis, diabetes, dementia, malnutrition, polyphar-

macy… Particular attention must be payed to use of steroids, beta-blockers, ACE inhibitors, diuretics, insulin or hypoglycaemic agents and anticoagulants.

## Physiology of aging

Aging is a universal and progressive physiologic phenomenon characterized by degenaritive changes in both the strucure and the functional reserve of organs and tissues. Aging is a consequence of free radicals damage within mitochondrial DNA (oxidative stress) *(3)*. Elderly patients (arbitrarily defined as being over 65 years of age) are vulnerable to the adverse effects of anaesthesia. With advancing age, the autonomic nervous system, heart and blood vessels become less capable of maintaining haemodynamic stability. Increased arterial rigidity and increased sympathetic nervous system activity contribute to the increase in systemic vascular resistance. Increased stiffness of the hypertrophied elderly cardiac ventricle leads to increased end-diastollic pressure with severe diastolic dysfunction.With advancing age, parasympathetic activity decreases while sympathetic neural activity increases. Elderly subjects manifest a reduced responsiveness to beta-adrenergic stimulation and reduced baroreceptor reflex *(4)*. Changes in the respiratory system with age comprise: decline in compliance of bony thorax, loss of respiratory muscle mass, decrease in alveolar gas exchange surface and decrease in central system responsiveness. Aged lungs have some features of chronic obstructive lung disease, increased residual volume, reduced vital capacity and FEV1.

The target organ for all anaesthetic agents is the central nervous system. Aging produces a decrease neural density and loss of 30 % brain mass at the age of 80 years (mostly grey matter). Signs of peripheral nervous system aging are marked by a loss of motor, sensory and autonomic fibers and decrease in conduction velocity. Aging decreases functional capacity of other organ system such as hepatic, renal and endocrine system. Administration of drug in the elderly compared to young subjects results in higher blood levels, due to a smaller volume of distribution and due to a slower drug metabolism. The brain is more sensitive to the drug in the elderly and all these effects conspire to increase the lenght of time that drug is active in the elderly patient.

## Intraoperative anaesthetic management

In geriatric patients there is reduction of cardiovascular, respiratory, renal and liver functions. There is very little functional reserve (difference between the basal and maximal function of organs) which is safety margin available to the patient during anaesthesia and the postoperative period. Trauma, surgery and administration of anaesthetic drugs often affect cardiovascular physiology to great degree. Randomized studies and a meta-analysis of several randomized clinical trials in non-cardiac surgery patients, comparing outcome with regional and general anaesthetic techniques have shown little evidence of improved outcome and reduced post-operative morbidity and mortality *(5, 6)*. The importance of management in keeping adequate organ perfusion pressure is often underlined.

Anaesthesia should be safe with smooth induction, maintenance and quick reversal without producing any cardiovascular, respiratory and nervous complications. Multiple retrospective and prospective studies have arrived at the same conclusion. No significant difference in outcome can be attributed solely or predominantly to the use of any specific agent, and no clear and objective benefit can be demonstrated for using regional rather than general anaesthesia. Choice of anaesthesia depends on the patient's general condition, nature of surgical procedure and the experience of the anaesthesiologist. Psychological preparation, appropriate premedication and patient prewarmed is important. Airway maintenance may be more difficult because of osteoporotic mandibles, temporo-mandibular joint stifness, loose teeth, cervical spondylosis… Maintenance of normothermia is essential because older patients have an impaired ability to sense a colder temperature, less subcutaneous fat, reduced heat generation, reduced ability to vasoconstrict and shiver.

## Central neural blockade

Neuraxial anaesthetic techniques include spinal and epidural blocks. Both techniques can result in sympathetic blockade, resulting in decreases in both preload and afterload and ultimately reducing cardiac output. The decision to use neuraxial anesthesia for the high-risk cardiac patient may be influenced by the dermatomal level of the surgical procedure. Older age is associated with a higher upper level of anaesthesia after epidural administration of local anaesthetic. Higher levels of anaesthesia were attributed to reduced leakage of local anaesthetic because of progressive sclerotic closure of the intervertebral foramina. Epidural blockade that is restricted to the level of the low thoracic and lumbar region (T5-L4) results in a peripheral sympathetic blockade with vascular dilatation in the pelvis and lower limbs and decrease in mean arterial pressure. This decrease is compensate with a reflex increase in efferent sympathetic vasoconstriction above the level of the block, by release of catecholamines from the adrenal medulla. This increased activity may result in increased cardiac contractility and increased heart rate. Reduction in mean arterial pressure during lumbar epidural anaesthesia may increase myocardial ischemia in some patients with coronary artery disease. Activation of the sympathetic nervous system may result in myocardial ischemia and infarction. Atrial fibrillation and tachycardia are common after cardiac and thoracic surgery. Thus, sympathetically mediated decreases in myocardial oxygen supply may be a major factor of postoperative cardiac morbidity. Selective blockade of cardiac sympathetic inervation (T1-T5) can most easily be achieved by administrating local anaesthetics through an epidural catheter placed at an upper thoracic level, a technique commonly known as thoracic epidural anaesthesia (TEA). TEA significantly reduced incidence

of supraventricular tachyarrhytmias after pulmonary resections *(7)*. Cardiac sympathetic blockade by TEA dilates stenotic coronary arteries and has been used to control pain in patients with unstable angina. The anti-ischemic and anti-anginal effects of continuous TEA are superior to those of conventional therapy in the treatment of refractory unstable angina *(8)*. Postoperative myocardial infarction, respiratory and renal failure, stroke and mortality were reduced by TEA, but not by lumbar epidural analgesia. TEA containing a local anaesthetic dilates stenotic coronary arteries and increases myocardial oxygen supply, decreases myocardial oxygen consumption, decreases myocardial ischaemic events and postoperative myocardial infarction. Lumbar epidural analgesia with a local anaesthetic, on the other hand dilates arteries of the lower part of body, constricts coronary arteries and decreases myocardial oxygen supply *(9)*.

In summary we can say that epidurals for major surgery offers better pain control in the postoperative period and improves patient satisfaction. The Multicentre Australian Study of Epidural Anesthesia found no difference in outcome between patients receiving perioperative epidural analgesia and those receiving intravenous opioids *(10)*.

## Thoracic paravertebral blockade

Continuous thoracic paravertebral blockade (TPB) either unilaterally or bilaterally has been useful in minimally invasive cardiac surgery to provide excellent analgesia while allowing early ambulation *(11)*. There is also a potential advantage of avoiding central neuraxial haemathoma with this technique. It was presented that TPB can resolve ST segment depression during general anaesthesia and thus is useful in treatment of angina pectoris *(12)*.

The studies which compared TPB with TEA found no difference in analgesia. In the study of Richardson et al. was found that TPB (bupivacaine) was superior in terms of analgesia, pulmonary functions, neuroendocrine stress responses, side effects and postoperative respiratory morbidity compared to TEA (bupivacaine) *(13)*.

In the study of Casati and co-workers was shown that continuous thoracic paravertebral analgesia is as effective as epidural blockade in controlling a post-thoracotomy pain, but is associated with less haemodynamic effects *(14)*.

In patients undergoing minimally invasive direct coronary artery bypass surgery TEA and TPB were compared. The quality of analgesia was comparable within the groups. TPB is technically easier than TEA and may be safer than TEA because no complication were seen in the TPB group *(11)*.

Two recent systematic reviews have confirmed the efficacy of paravertebral blockade for post-thoracotomy analgesia *(15, 16)*. Systematic reviews found no difference in analgesia with TPB techniques when compared with TEA regimens. Important side effects such as hypotension, urinary retention, nausea and vomiting, were less frequent with TPB than with TEA. Davies et al. compared TPB with TEA and confirmed that the quality of analgesia was equivalent but there were fewer side effects and complications with TPB *(16)*. The Prospect group looked at all randomized trials where regional technique was used (epidural, paravertebral, intrathecal, intercostals and interpleural). Again, on the balance of equivalent or superior analgesia and less adverse events, TPB is recommended for post-thoracotomy analgesia *(15)*. Compared to the other available regional techniques such as intercostals and interpleurals TPB offers better quality, longer duration of analgesia and less side effects.

## Valvular heart disease

Patients with VHD are at highr risk of perioperative cardiovascular complications during non-cardiac surgery. Severe aortic stenosis defined as with valve area $<1$ cm$^2$ associated with transvalvular gradient of 50 mmHg and with symptoms syncope, angina,dyspnea should be considered for valve replacement before elective surgery. The goals in anaesthetic management are to maintain normal blood pressure and heart rate, to maintain preload, to avoid abrupt decrease in afterload. In severe aortic stenosis central neuraxial blocks are relatively contraindicated, anaesthesiologist should consider the use of peripheral nerve blocks. Cardiopulmonary resuscitation may be problematic as chest compressions may not generate pressures great anough to overcome valve gradient.

In aortic regurgitation reduction in peripheral vascular resistance such as that produced by neuraxial blocks promotes forward flow and reduces the regurgitation fraction. Abnormal reductions in blood pressure should be avoided because it may cause significant reduction in diastolic filling pressure with subsequent myocardial ischemia or cardiovascular collapse.

In patients with mitral stenosis is important to prevent tachycardia and fluid overload to avoid pulmonary oedema. In patients with severe mitral regurgitation and impaired LV ejection fraction $<$ 30 % non-cardiac surgery should be performed only if necessary.

Although many clinicians believe that regional anaesthesia is safer than general anaesthesia, randomized studies comparing the two modalities have shown no difference in cardiopulmonary complications or mortality. It has been estimated that the number of patients needed for a randomized clinical trial to determine whether epidural anaesthesia and analgesia would affect mortality in patients undergoing high-risk vascular surgery would be 24 000, while enrolment of 1.2 million would be needed in a low-risk procedure *(17)*. Combined epidural and general anaesthesia with analgesia for pain control may attenuate sympathetic hyperactivity, reduce the need for additional parenteral analgesia postoperatively, improve postoperative pulmonary funcion and reduce the duration of stay in the intensive care unit following surgery.

Placement of the needle epidurally or intrathecally may not be easy in elderly patients, anatomic changes and deformities (calcified ligaments, osteophytes) limit the acces to the neuraxis.

## Peripheral nerve blocks

Peripheral nerve blocks are used frequently in elderly patients. Sensory and motor blocks last longer in elderly than in younger patients (approximately 2.5 times longer). These alterations are attributed to a decrease in the conduction velocity of the peripheral nerves and to a gradual degeneration of the peripheral nervous system. By the age of 90 years, one third of the myelinated fibers have dissapeared from peripheral nerves *(18)*.

## Postoperative cognitive dysfunction (POCD)

The target organ for anaesthetic drugs is the brain. Clinicians assumed for many years that their effects do not outlast their pharmacological action and that the target organs are restored to their previous state once the agent is eliminated. The novel evidences showed that this is not true. The long term or even permanent neurological damage can occur following administration of anaesthetic drugs. The central nervous system is particularly vulnerable at the beginning and end of its life. Cognitive impairment (delirium, confusion) is a significant problem in elderly patients during the early postoperative period. The occurence of postoperative delirium in the elderly can result in increased morbidity, delayed functional recovery and a prolonged hospital stay. Several etiologic mechanisms have been suggested: brain hypoxia, residual concentrations of general anaesthetics, and their effect on cholinergic or glutaminergic neurotransmission, and stress response to surgical procedure. POCD is defined as the mental processes of perception, memory and information processing which allows the individual to acquire knowledge, solve problems and plan for the future *(19)*. It comprises the mental processes required for everyday living, not intelligence *(20)*. International Studies of Postoperative Cognitive Dysfunction (ISPOCD) were used various neuropsychological tests to define POCD *(21, 22)*.

In the randomised study 438 elderly patients had been included. No significant difference was found in the incidence of cognitive dysfunction 3 months after either general or regional anaesthesia. Regional anaesthesia may decrease mortality and the incidence of POCD early after surgery *(23)*. The incidence of POCD in elderly patients was influenced not only by anaesthetic technique, but far more by extension of surgical procedure, postoperative complication, stress response and hospitalization.

ISPOCD 2 multicentric study showed less cognitive dysfunction in the first postoperative week in the elderly patients undergoing minor surgery *(24)*.

Various factors such as age, limited education, second operation, surgical complications and stress, rather than anaesthetic technique can affect the incidence of POCD *(25)*.

## CONCLUSIONS

Regional anaesthesia offers several advantages to elderly patients because it provides postoperative analgesia with minimal sedative side effects. Neuraxial anaesthesia may reduce the incidence of thromboembolic complications in geriatric patients, especially following orthopedic and lower extremity vascular surgery.

Regional anaesthesia appears to be safe and beneficial in the elderly patients, however particular consideration should be given to the health status of the patient, the operation being performed and the expertise of the anaesthesiologist.

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