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Clinical experience

Regional anaesthesia and chronic renal disease

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Abstract

Chronic kidney disease (CKD) has become increasingly prevalent in our aging patient population, especially because glomerular filtration rate (GFR) and renal reserve decline progressively as we grow older. The most common causes of CKD are diabetes mellitus, hypertension and glomerulonephritis. The aim of this article is to present different regional techniques relevant to patients with CRF. We also reviewed possible complications and specificities that should be addressed when administering regional anesthesia.

INTRODUCTION

Chronic kidney disease (CKD) is defined as the presence of kidney damage (usually detected as urinary albumin excretion of 30 mg/day or more, or equivalent) or decreased kidney function (defined as a glomerular filtration rate less than 60 ml/min/1.73 m^2) for three or more months. Recent professional guidelines classify the severity of chronic kidney disease in five stages, with stage 1 being the mildest and usually causing few symptoms and stage 5 being a severe illness with poor life expectancy if untreated. Stage 5 CKD is often called End Stage Renal Disease (ESRD) and is synonymous with the now outdated terms chronic kidney failure (CKF) or chronic renal failure (CRF).

A wide range of disorders may develop as a consequence of the loss of renal function. These include disorders of fluid and electrolyte balance, such as volume overload, hyperkalemia, metabolic acidosis, and hyperphosphatemia, as well as abnormalities related to hormonal or systemic dysfunction, such is anorexia, nausea, vomiting, fatigue, hypertension, anemia, malnutrition, hyperlipidemia and bone disease.

Platelet dysfunction in chronic kidney disease

From regional anesthesia aspect special attention should be payed in increased tendency of bleeding in acute and chronic kidney disease *(1)*. This appears to correlate most closely with prolongation of the bleeding time, due primarily to impaired platelet function. Anemia, dialysis, the accumulation of medications due to poor clearance and anticoagulation used during dialysis have some role in causing impaired hemostasis in ESRD. Platelet dysfunction occurs both as result of intrinsic platelet abnormalities and impaired platelet–vessel wall interaction *(2, 3)*. The normal platelet activation, recruitment, adhesion and aggregation is defective in advanced renal failure. Dialysis may partially correct these defects, but cannot totally eliminate them. The hemodialysis process itself may in fact contribute to bleeding *(4)*. Hemodialysis is also associated with thrombosis as a result of chronic platelet activation due to contact with artificial surfaces during dialysis.

Anticoagulation and chronic renal disease

Renal clearance is the primary mode of elimination for several anticoagulants, including LMWH (low molecular weight heparin), fondaparinux, and the new oral factor Xa and IIa inhibitors. Therefore, with reduced renal function, these drugs may accumulate and may increase the risk of bleeding, particularly in elderly patients and those at high risk for bleeding *(5)*. The relationship between renal impairment and drug accumulation for the various LMWHs appears to be variable and may be related to the chain length distribution of the different LMWH preparations *(6)*. Two recent studies in hospitalized patients, the majority of whom were critically ill and had creatinine clearances less than 30 mL/min, have shown no bioaccumulation of dalteparin 5000 U once daily based on serial anti-factor Xa levels *(7)*. Therefore, they do not reduce the prophylaxis dose of dalteparin in patients with renal insufficiency.

With enoxaparin thromboprophylaxis, we suggest that 30 mg once daily be used. We also suggest that fondaparinux, rivaroxaban and dabigatran be avoided unless future evidence demonstrates that these agents can be used safely in patients with severe renal insufficiency.

Comparison of local and regional technique for creation AVF

Regional anesthesia is administered to different locations in patients with CRF. Literature primarily cites importance of regional anesthesia in creating AV fistulas, comparing effect on fistula flow in local and regional anesthesia techniques *(8, 9)*. Approximately 25% of initial arteriovenous fistula (AVF) placements will fail as a result of thrombosis or failure to develop adequate vessel size and blood flow. Fistula maturation is impacted by patient characteristics and surgical technique, but both increased vein diameter and high fistula blood flow rates are the most important predictors of successful AVFs. Anesthetic techniques used in vascular access surgery (local anaesthesia and regional blocks) may affect these characteristics and fistula failure. Significant vasodilation after regional block administration is seen in both the cephalic and basilic veins. These vasodilatory properties may assist with AVF site selection. In the intraoperative and postoperative periods, use of a regional block, compared with other anesthetic techniques, resulted in significantly increased fistula blood flow. The greater sympathetic block contributed to vessel dilation and reduced vasospasm. Use of regional techniques in AVF construction yielded shorter maturation times, lower failure rates, and higher patency rates.

Spinal anaesthesia

Neuroaxial block (spinal anesthesia) has it place in patients with CRF. It is administered whenever there is an indication because it is logical choice as it avoids the effects of muscle relaxants, narcotics and potent volatile anesthetics. Symphatetic blockade is an important consideration when utilizing epidural or spinal anaesthesia. A high level of blockade can result in a significant drop in blood pressure and GFR. Careful preoperative fluid loading will help offset the degree of hypotension. It should be remembered that patients with autonomic neuropathy will not able to adequately compensate for a fall in blood pressure as would a normal patient.

As acidosis decreases the central nervous system threshold to the toxic effects of local anaesthestics, the total of anaesthetic should be decreased by approximately 25 per cent in the acidotic patient *(10)*. Cardiotoxicity of local anesthestics has been described; more with bupivacaine then with levobupivacaine so later should the used *(11)*.

The use of regional anaesthesia in patients with uremic neuropathy is controversial. Neuropathy is a common complication of end-stage kidney disease (ESKD), typically presenting as a distal symmetrical process with greater lower-limb than upper-limb involvement. The condition is of insidious onset, progressing over months. and has been estimated to be present in 60%–100% of patients on dialysis. Neuropathy generally only develops at glomerular filtration rates of less than 12 ml/min. The most frequent clinical features reflect large-fiber involvement, with paresthesias, reduction in deep tendon reflexes, impaired vibration sense, muscle wasting, and weakness (*12*). Most anesthetists will agree that its use is contraindicated, although some authors differ.

The transverse abdominal plane (TAP) block

The transverse abdominal plane (TAP) block has proven effective in reducing opioid requirements and pain scores for some procedures involving the lower abdominal wall. In the study of Freir et al. they assessed its efficacy in patients with end-stage renal failure undergoing cadaveric renal transplantation *(13)*. The addition of a TAP block to the analgesia regimen for renal transplantation did not reduce morphine requirements. Controversial results has been published in paper by Mukhtar et al, where reduce dose of opioids has been shown after TAP block.

CAPD and regional anaesthesia

In our institution CAPD catheters are introduced and removed by laparoscopic technique using spinal anesthesia. We did not have any complications, but patients has reported shoulder pain, headache, nausea, and discomfort due to pneumoperitoneum during procedure. In general, patient cooperation and satisfaction are good. In paper by Tzovaras et al. identical results has been shown as we had in our study that were comparing spinal and general anesthesia during laparoscopic cholecystectomy *(15)*.

Kidney transplantation and regional anesthesia

The earliest kidney transplants were all done under regional anesthesia, however the recent trend has been towards general anesthesia. A small (n=50), randomized, controlled trial comparing general to regional anesthesia

found no significant difference in total anesthesia time, surgical time, or any hemodynamic variables measured *(16),* and a subsequently published case series showed a 92% success rate using combined spinal-epidural anesthesia and no significant intraoperative hemodynamic changes *(17)*.

CONCLUSION

Regional anesthesia has it place in patients with CRF. It is administered whenever there is an indication, because it is logical choice as it avoids the effects of muscle relaxants, narcotics and potent volatile anaesthetics. It is useful to administer brachial plexus block and spinal anesthesia as standard procedures. Literature increasingly cites transverse abdominal plane (TAP) block, but it is still not a standard procedure. Also established technique of spinal anaesthesia is introduced in procedures like CAPD catheter insertion and kidney transplantation.

Attention should be payed to specificities in patients with CRF: increased tendency of bleeding, increased cardio and neuro toxycities of local anesthetic and uremic neuropathy in certain patients.

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