

Research Article

Hemodynamic effects of angiotensin inhibitors in elderly hypertensives undergoing total knee arthroplasty under regional anesthesia



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Abstract

The aim was to investigate the association between continuing angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARB) with postinduction hypotension and vasoactive drug use in elderly orthopedic surgery patients under regional anesthesia. Retrospective design consisted of 114 patients (mean age 66) undergoing elective total knee arthroplasty, including 84 patients with chronic hypertension, and they were divided as group I (n = 37), ACEI/ARB continued; group II (n = 23), ACEI/ARB withdrawn; group III (n = 24), β -blocker/calcium channel blocker continued; and group IV (n = 30), without hypertension (control). Primary end points are systolic blood pressures (SBPs) and mean arterial blood pressures (MAPs) at 0, 30, 60, and 90 minutes postinduction, incidence of hypotension (SBP <85 mm Hg), and ephedrine requirements. Repeated measurements were analyzed using generalized estimating equations controlling for baseline characteristics and accounting for correlations. Logistic regression was used for remaining variables. Hypotension occurred more frequently ($P = .02$) in group I (30%) versus groups II–IV (9%, 13%, 3%). Ephedrine use was increased ($P < .001$) in group I (51%) compared with groups II–IV (26%, 17%, 7%). Group I had lower mean SBPs compared with group II (110 vs. 120; $P = .0045$) and group IV (110 vs. 119; $P = .0013$). Lower mean MAPs were found in group I versus group II (74 vs. 81, $P = .001$) and group IV (74 vs. 80; $P = .001$). Group I had an increased odds of receiving ephedrine versus group IV (odds ratio, 16.27; 95% confidence interval, 3.10–85.41; $P = .001$). No adverse clinical events were recorded. Day of surgery ACEI/ARB use is associated with a high incidence and severity of postinduction hypotension with associated high vasopressor requirements. Associated clinical outcomes merit further study. *J Am Soc Hypertens* 2014;8(9):644–651. © 2014 American Society of Hypertension. All rights reserved.

Keywords: Angiotensin converting enzyme inhibitors; angiotensin receptor blockers; hypotension; vasopressor.

Introduction

Hypertension and the well-known risks of ischemic events and mortality associated with this condition¹ are especially important to manage in the perioperative setting. With increasing rates of hypertension, the prevalence of patients with chronic hypertension undergoing total joint arthroplasty is increasing.² Frequently, these patients are chronically treated with angiotensin-converting enzyme inhibitors (ACEIs) and angiotensin receptor blockers (ARBs). The mechanisms of action of ACEIs involve vasodilatation and decreasing venous return by blocking the synthesis of

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angiotensin II, a potent vasoconstrictor, which causes a rise in the vasodilator bradykinin.³ ARBs act through selective blockade of angiotensin II receptor binding.³

A significant number of knee arthroplasties are performed under neuraxial regional anesthesia⁴ given its association with reductions in intraoperative blood loss, lower thrombotic and respiratory complications, improved pain control, and shorter rehabilitation times compared with general anesthesia.^{5–7} Hemodynamic effects of neuraxial anesthetics are chiefly because of a chemical sympathectomy causing reduced vascular capacitance leading to a decreased effective circulatory volume.³ The result is pooling of intravascular volume in the lower extremities and associated hypotension. This effect poses unique concerns for patients chronically treated with ACEIs and ARBs for two reasons. First, hemodynamic stability during epidural induced hypotension is largely maintained by the interplay of the renin–angiotensin, sympathetic and vasopressin systems,^{3,8} and secondly, intraoperative hypotension compounded by preoperative fasting is a risk factor for stroke⁹ and cardiac ischemia which may occur silently in the anesthetized patient.¹⁰

Importantly, perioperative use of ACEIs and ARBs has been associated with early postinduction hypotension requiring the use of vasopressors in vascular and general surgery patients under general anesthesia.^{11–15} Further associations with the use of these drugs include acute kidney injury in patients undergoing cardiovascular surgery¹⁶ and increased perioperative mortality in coronary bypass patients.¹⁷ Case studies have described severe postinduction hypotension^{18,19} and even cardiac arrest²⁰ in ACEI- and ARB-treated patients under regional anesthesia which has wide implications for elderly, orthopedic surgery patients. To date, there is a paucity of data addressing this topic in noncardiac patients and there exists variability in the practice of preoperative ACEI and ARB withholding by practitioners.

The aim of this retrospective cohort study was to compare postinduction hemodynamics between four groups of patients undergoing elective total knee arthroplasty patients under neuraxial anesthesia including: (1) those who continued chronic ACEI/ARB therapy on the day of surgery (DOS), (2) those in whom ACEIs/ARBs were withdrawn on the DOS, (3) those who continued alternative antihypertensives, and (4) those patients without hypertension not on therapy. We hypothesized that greater postinduction blood pressure reductions along with greater vasopressor requirements would be associated with continuation of ACEI/ARB therapy.

Methods

Data collection and analysis in this study was performed with the approval of the Institutional Review Board at the Hospital for Special Surgery. Protected health information

was handled in accordance with the requirements of the Health Insurance Portability and Accountability Act. Data were collected retrospectively by paper record and electronic chart review.

From a total of 1298 patients aged 60–75 who underwent elective orthopedic surgery between the time period from January and March 2010 at the Hospital for Special Surgery, 114 eligible patients of a total 277 total patients undergoing unilateral total knee arthroplasty under neuraxial anesthesia were studied. This time period was chosen to avoid any considerable temporal variation in the practice of either withholding ACEIs or ARBs 24 hours before surgery or continuing them on the DOS. Eligible patients were those who underwent unilateral total knee arthroplasty under neuraxial anesthetic technique and had an admission diagnosis of chronic hypertension. Excluded were patients who initiated antihypertensive therapy on the DOS; those in whom antihypertensives were used for conditions other than chronic hypertension; patients with active cardiac, renal, or hepatic failure; patients undergoing general anesthesia; charts with incomplete operating room documentation; additional surgery other than total knee arthroplasty; and baseline hypotension. Diuretics are routinely held on the DOS as per institutional practice. To investigate the effects of renin–angiotensin inhibition versus noninhibition on postinduction hemodynamics and to minimize the number of intergroup comparisons, ACEIs/ARBs and β -blockers/calcium channel blockers (BB/CCB) were combined into their respective groups. These antihypertensive group pairings are consistent with those made in prior related studies^{12,14} involving patients under general anesthesia. Eighty-four patients with a diagnosis of chronic hypertension were identified and were divided into the following groups based on antihypertensive class and withholding status on the DOS: group I, ACEI/ARB continued ($n = 37$); group II, ACEI/ARB withdrawn ($n = 23$); and group III, BB/CCB continued ($n = 24$). Thirty age-matched controls without hypertension and on no therapy comprised of group IV. ACEIs and ARBs included in this study are as follows: benazepril 20–40 mg, enalapril 10–20 mg, lisinopril 10–40 mg, quinapril 10–40 mg, ramipril 5–10 mg, candesartan 32 mg, irbesartan 150–300 mg, losartan 50–100 mg, olmesartan 40 mg, telmisartan 40 mg, and valsartan 40–320 mg. BB and CCB used in this study include the following: atenolol 25–100 mg, acebutolol 200 mg, bisoprolol 10 mg, carvedilol 20–40 mg, metoprolol 12.5–100 mg, amlodipine 2.5–10 mg, diltiazem 90–180 mg, felodipine 5 mg, and nifedipine 60 mg.

All chart data were collected by the primary investigator. The study investigators were neither blinded to outcomes of interest or to which antihypertensives were used nor were the anesthesiologists blinded to antecedent antihypertensive medication therapy during a surgical case. Specific baseline demographics collected were age, gender, body mass index, American Society of Anesthesiologists (ASA) status, serum

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