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Incidence and management of hypotension in spinal anaesthesia in urological pelvic surgery

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ABSTRACT

The management of hypotension in specific clinical contexts frequently involves the administration of ephedrine; a vasopressor with demonstrated efficacy across multiple scenarios: spinal anaesthesia for uro-pelvic surgery, caesarean section, renal transplantation, and select cases of autonomic dysfunction. Recent evidence suggests that ephedrine use may delay the onset of hypotension. This prospective study has evaluated the incidence and management of hypotension in 80 adult patients (aged 17–45 years) undergoing urological pelvic surgery under spinal anaesthesia. Participants were recruited from the Hilla Teaching Hospital and the Al-Imam Al-Sadeq Teaching Hospital (Iraq) between June 2023 and December 2024, and were randomly assigned to receive either intravenous fluids alone or in combination with ephedrine. Systemic blood pressure was monitored at four time points: preoperatively, following intervention, after anaesthesia induction, and postoperatively. Compared to fluid administration alone, the ephedrine-treated group exhibited significant changes in both systolic and diastolic blood pressure values ($p<0.05$). These findings suggest that ephedrine enhances haemodynamic stability during spinal anaesthesia and may play a clinically significant role in the intraoperative management of hypotension.

1. Introduction

Hypotension is a common complication associated with spinal anaesthesia, particularly in urological pelvic (uro-pelvic) procedures[1]. If

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inadequately managed, hypotension can result in significant morbidity[2]. Its incidence during spinal anaesthesia may range from 30% to 70%, depending on several variables, including patient positioning, age[1], and the administration of fluids or vasopressors[3,4]. Physiologically, hypotension during spinal anaesthesia is largely attributed to sympathetic blockade, which induces vasodilation and reduces venous return, ultimately leading to decreased cardiac output[5]. Additionally, the Bezold-Jarisch reflex (mediated by serotonin receptors) has been implicated as a contributing mechanism[5]. Given the potential risks associated with intraoperative hypotension, active management is essential. While intravenous fluid (IVF) therapy has traditionally served as the first-line treatment, increasing attention has been directed toward the adjunctive use of vasopressors such as ephedrine for a more effective control of blood pressure[6].

This prospective study aimed at comparing the efficacy of IVF alone *versus* IVF combined with ephedrine in the management of hypotension during spinal anaesthesia in elective uro-pelvic procedures. The study has investigated the incidence of hypotension and evaluates blood pressure (BP) responses across two therapeutic modalities, with the goal of informing optimized anaesthetic care and improving patient outcomes.

2. Methodology

A total of 80 adult patients (aged 17–45 years) scheduled for elective uro-pelvic surgeries under spinal anaesthesia were prospectively enrolled. Participants were recruited from the Hilla Teaching Hospital and the Al-Imam Al-Sadeq Teaching Hospital (Iraq) between June 2023 and December 2024. Subjects were randomly allocated to two groups: group 1 (N=38) received IVF alone, while group 2 (N=42) received IVF combined with 6 mg of injectable ephedrine. Inclusion criteria comprised adults aged 17 to 45 years who provided informed consent. Exclusion criteria included contraindications to spinal anaesthesia or ephedrine, as well as the presence of chronic or advanced cardiovascular disease.

Spinal anaesthesia was administered using a 25-gauge Whitacre needle introduced into the subarachnoid space at either the L3/L4 or the L4/L5 interspace. Procedures were performed with patients in either the lateral or sitting position, adhering to institutional protocols for local anaesthetic administration. Following anaesthesia induction, patients were monitored for BP, heart rate, and oxygen saturation. Treatment was initiated immediately after the spinal anaesthesia onset. BP readings were recorded at four key intervals: preoperative baseline, post-anaesthesia, post-treatment, and upon surgery completion. Demographic variables (age, gender, weight, and height) were collected. Hypotension was defined as a ≥20% reduction in systolic BP from baseline or an absolute systolic BP being <90 mmHg. Incidence rates and supplementary interventions were documented.

Statistical analysis included descriptive statistics for demographic data. The Shapiro–Wilk test was used in order to assess the normality of the obtained BP data. Between-group comparisons were performed by using independent samples *t*-tests for normally distributed data and Mann–Whitney U tests otherwise. Categorical variables were analysed *via* the chi-square test. Statistical significance was defined as $p<0.05$.

Ethical approval was obtained from the Hammurabi College of Medicine's Institutional Ethics Committee (reference: HCM-CR-1-20-2024). Written informed consent was secured from all participants in accordance with established ethical guidelines.

3. Results and Discussion

Table 1 summarizes the descriptive statistics for systolic BP (SBP), diastolic BP (DBP), and age distribution across both treatment groups. No statistically significant differences were observed between the groups at baseline (preoperative SBP and DBP), following anaesthesia, or immediately post-treatment. However, significant differences ($p<0.05$) were noted in SBP and DBP after ephedrine administration and at the end of surgery, thereby indicating that ephedrine may confer a haemodynamic advantage during critical procedural phases.

Haemodynamic stability is vital during spinal anaesthesia for uro-pelvic procedures. This study demonstrates that ephedrine, when used adjunc-

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Table 1				
Variable	**Category**	**Fluids** (N=38)	**Fluids + Ephedrine** (N=42)	***p*-value**
Age distribution	<20 years	2	1	0.07
	21–30 years	9	3	
	31–40 years	10	9	
	41–45 years	17	29	
Preoperative blood pressure	systolic blood pressure	133.3 ± 16.4	134.5 ± 13.6	0.79
	diastolic blood pressure	88.9 ± 11.7	86.6 ± 8.2	0.46
Blood pressure after spinal anaesthesia	systolic blood pressure	83.7 ± 9.8	85.0 ± 10.9	0.71
	diastolic blood pressure	44.5 ± 9.4	45.3 ± 7.4	0.77
Blood pressure after treatment	systolic blood pressure	128.7 ± 20.0	122.5 ± 18.9	0.01
	diastolic blood pressure	84.0 ± 14.1	82.0 ± 9.9	0.02
Blood pressure at the end of the surgery	systolic blood pressure	119.6 ± 19.0	111.3 ± 17.9	0.04
	diastolic blood pressure	77.5 ± 14.6	75.2 ± 11.2	0.04

tively with IVF, significantly improves BP parameters compared to IVF alone. These findings corroborate those of the literature indicating that ephedrine increases heart rate and peripheral vascular resistance, thereby optimizing cardiovascular performance during acute hypotensive episodes[6,7].

Despite its benefits, ephedrine may cause adverse effects such as hypertension, tachycardia, and cardiac arrhythmias, which can complicate intraoperative monitoring. In select patients (particularly those with pre-existing cardiovascular conditions), alternative agents such as noradrenaline may be preferred for sustained hypotensive management[8].

A systematic review of ephedrine's safety profile concluded that most adverse events are transient and mild, although vigilant perioperative monitoring remains essential[9]. Clinicians must carefully weigh the haemodynamic benefits of ephedrine against its potential risks[10]. The incidence of hypotension also appears to vary with surgical complexity. Procedures involving extensive pelvic manipulation or longer durations, such as radical prostatectomy, are associated with higher rates of hypotension than more minor interventions like cystoscopy[5,10]. This necessitates individualized anaesthetic strategies tailored to both patient-specific and procedural variables.

The age distribution between groups was comparable (p=0.07), thereby supporting the internal validity of treatment comparisons. Although acute hypotension may result in postoperative complications – including organ hypoperfusion and nausea – there remains a paucity of data on its long-term consequences[7]. Some studies suggest a correlation between recurrent intraoperative hypotensive episodes and higher postoperative morbidity, but definitive conclusions require further longitudinal research[5].

4. Conclusion

This study affirms the clinical relevance of targeted therapeutic strategies for managing hypotension during spinal anaesthesia in uro-pelvic surgery. The combination of IVF with ephedrine demonstrates promise as an effective modality for the enhancement of haemodynamic stability. Larger-scale studies are warranted to validate these findings and to establish optimal dosing regimens for ephedrine and alternative vasopressors across various surgical contexts.

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Conflicts of interest

None exist.

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