



# Management of obstetric spinal hypotension in resource-limited areas

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## ABSTRACT

Hypotension following obstetric spinal anesthesia is a common problem and has remained a focus of research and controversy for many decades. Recent advances on this subject have resulted in numerous recommendations for management of obstetric spinal hypotension. However, these advances have failed to reduce the unacceptable number of fatalities that occur in resource limited environments which constitutes more than 75% of the world's population. The reason being the failure of translation of the research done in resource-rich environments, and its application and performance in resource-poor environments. This review focuses on the problems faced by clinical environment that are deficient in appropriate resources and manpower. It further proposes an outline for management of spinal hypotension and recommends suitable research agenda to address the deficiencies.

**Key words:** Hypotension; Anesthesia, spinal; Obstetric; Research

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## INTRODUCTION

Obstetric patients develop more extensive spinal blocks than non-pregnant patients. As a result hypotension following obstetric spinal anaesthesia is a common problem and has remained a focus of research and controversy for decades. Recent advances have created a better understanding of hemodynamics and choice of vasopressors for prevention and treatment of spinal hypotension.<sup>1-3</sup> It has led to the development of recipe for prevention and management of hypotension following obstetric spinal anesthesia.

However, research advances in developed world have not been translated into practical guidelines to reduce the unacceptable high maternal mortality rate prevalent in resource-limited clinical settings. World Health Organization report on maternal mortality from the year 1990-2015, stated that 99% of all global maternal deaths are from developing nations.<sup>4</sup> International obstetric anesthesia guidelines recommend spinal and epidural anesthesia over general anesthesia (GA) for most cesarean sections

(CSs).<sup>5,6</sup> However, South African confidential inquiry report from years 2011–2013 showed that more than half of the anesthesia-related maternal deaths were related to spinal hypotension, almost all of which were preventable and could have been avoided.<sup>7</sup>

Therefore, it seems that there is a disparity in the research led recipe for management of spinal hypotension from resource-rich environments OSH and its application and performance in environments where resources are poor or deficient. This article attempts to focus on management of OSH in resource-limited areas.

## IMPORTANCE OF THE CLINICAL ENVIRONMENT

While defining management strategies for obstetric spinal hypotension (OSH), it is necessary to distinguish between different clinical contexts, as there are marked differences in the availability of staff, equipment, drugs and infrastructure across different levels of the health sector.

Management strategies need to be adapted to match

## obstetric spinal hypotension

available clinical skill, drug availability, monitoring capabilities and infrastructure. Therefore, it is important to understand different levels of health sectors.

Suggested definitions of different health sectors in obstetric anesthesia are as follows;

- 1. Resource-rich health sector:** Availability of full anesthesia facilities including dedicated senior anesthesiologist with obstetric expertise, full monitoring facilities including invasive monitoring, infusion pumps, modern operating rooms, recovery facilities and adequate staff-patient ratio. Patient is always well-assessed by all teams and monitored in triage to make sure patients are well hydrated and optimized.
- 2. Resource-constrained health sector:** Dedicated junior anesthesiologist who lacks experience and has slower reaction times. Basic monitoring (NIBP/ECG/SpO<sub>2</sub>) is available in all cases. Anesthesia machine and infusion pumps are also usually available. Intermittent-level care is present and patients may or may not be fully assessed and may be dehydrated with unrecognized comorbidity. Overloaded working environment with delays in accessing operating rooms.
- 3. Resource-poor health sector:** Anesthesiologist, nurse or technician are on part-time job, have lack of experience, slower reaction times, multiple task of staff with divided attention, monitoring like NIBP and SpO<sub>2</sub> may or may not be present, Ambu bag and oxygen available. No infusion pumps; and inconsistent drugs found. Patients are not reliably assessed and managed preoperatively. Poor theatre design and no recovery facility

## CURRENT OBSTETRIC EVIDENCE ON OSH

Research on OSH has largely been performed under highly standardized research conditions, which may not reflect the conditions present in resource-limited settings. Over a decade, research has been focused on defining and predicting hypotension and describing hemodynamic changes during spinal anesthesia for CS. These have all contributed to the development of the current guidelines.

### Hemodynamic changes under spinal anesthesia:

Research on OSH has shown that it is predominantly caused by reduction in arterial sympathetic tone, with some contribution from venous dilatation.<sup>9</sup> The

resultant hypotension mainly leads to tachycardia,<sup>9</sup> although a small proportion of patients may respond with hypotension and bradycardia.<sup>10</sup> This understanding of mechanism of hypotension has helped in the improvement of clinical management and moving from a fluid-based strategy towards a vasopressor-based prophylactic strategy supported by fluid co-loading.<sup>11</sup> One of the previous study stated that heart rate may be 'the best surrogate indicator of cardiac output during obstetric spinal anesthesia.'<sup>12</sup> Taking heart rate as surrogate for cardiac output can be of particular importance in relevance to the resource-poor setting, where targeting simple surrogate outcomes such as heart rate could be practical and can be helpful while making clinical guidelines.

### Recommended strategies for managing spinal hypotension;

It is recommended to use a combination of fluid and a vasopressor for prevention and treatment of OSH. Phenylephrine is recommended as first-line agent,<sup>13</sup> expect for those patients who develop bradycardia associated with spinal anesthesia. The acceptance of phenylephrine is evident from the current literature, which is focusing on how phenylephrine should be given rather than a choice between vasopressors. Initial studies on this subject recommended high phenylephrine infusion rates (100 µg/min) and aggressive fluid co-loading.<sup>14,15</sup> This suggested regimen completely abolished hypotension but it caused reactive hypertension.<sup>14,15</sup>

Investigations that followed these studies used lower doses of prophylactic phenylephrine infusions.<sup>16</sup> Subsequent dose-finding studies including a meta-analysis recommending prophylactic phenylephrine infusions in a range of 25 - 50 µg/min.<sup>17,18</sup> Studies on hemodynamics of spinal hypotension suggested using baseline heart rate to maintain cardiac output during phenylephrine administration.<sup>1</sup>

Literature has shown that prophylactic phenylephrine infusions reduced maternal hypotension, nausea and vomiting without altering other relevant maternal or neonatal outcomes, and therefore, recommended titrated phenylephrine infusions co-administered with crystalloid for prophylaxis against spinal hypotension.<sup>11,18</sup>

## CURRENT GUIDELINES

All the work on prophylactic phenylephrine infusion has been done on elective CS in healthy parturients, operated in ideal clinical conditions. Therefore, recommendations from guidelines reflect caution in applying conclusions drawn from research on elective

## obstetric spinal hypotension

CS in healthy women to the urgent CS in women with comorbidity in different clinical environments. Therefore, guidelines from National Institute for Health and Care Excellence (NICE)<sup>19</sup> and South African guidelines,<sup>20</sup> offer the choice of ephedrine or phenylephrine as the vasopressor.

The NICE clinical guidelines for CS<sup>19</sup> state that 'Women who are having a CS under regional anesthesia should be offered intravenous ephedrine or phenylephrine, and volume pre-loading with crystalloid or colloid to reduce the risk of hypotension occurring during CS'.

Therefore, despite overwhelming evidence for the benefit of prophylactic phenylephrine infusions in elective patients, clinicians are reluctant to implement these findings even in the resource-rich setting in which this research was performed

### **PROBLEMS ASSOCIATED WITH ANAESTHESIA IN LOW RESOURCE SETTINGS**

Spinal hypotension is still causing more than half the anesthetic deaths.<sup>7</sup> This indicates that there exists a gap between the research conducted in resource-rich settings and the application of research to the resource-poor context. Therefore, there is a need to close this gap by developing management strategies according to the clinical conditions and resources available.

Mechanistic research has increased the understanding of physiology and hence anaesthesia practice: these principles can be applied equally in all clinical environment.<sup>(12)</sup> However treatment strategies involving drugs and sophisticated equipment differ according to the clinical environment. There is a paucity of literature from the resource limited areas that tests intervention strategy on patient outcomes.<sup>(21, 22)</sup>

Therefore the recipes on intervention strategies need to be refined and tested with pragmatic studies that evaluate the ability of institutions in different clinical environment to achieve success with various guidelines in resource-limited areas. This will require conducting well-designed, multicenter studies in resource-limited areas.

#### **Strategies in provision of effective anesthesia in low resource settings:**

Management strategies in resource-limited

environments must be specifically designed to meet the challenges that included inconsistent supply of equipment and drugs, inexperienced anesthesia providers, scanty staff fulfilling more than one role and poorly prepared patients.<sup>(8)</sup>

Strategies to combat hypotension on a pharmacological basis can be divided into 'reactive' or 'preventive' approaches. Reactive approaches generally involve early and aggressive treatment with fluid and a vasopressor bolus in response to a significant decrease in blood pressure. This strategy heavily relies on an alert and insightful anesthesiologist who can respond rapidly to subtle signals such as patient symptoms and changes in heart rate. This approach cannot be relied in resource-limited setting; therefore effective strategies in such setting should consider an emphasis on preventative, rather than reactive management.

Preventative strategies, such as prophylactic phenylephrine infusions, may limit the requirement for further interventions, but need to be carefully evaluated. Simple strategies such as fixed-rate, low-dose phenylephrine infusions have a low complication rate and provide acceptable hemodynamics stability.<sup>(23, 24)</sup> These intervention are particularly suited to the inexperienced anesthesiologist.<sup>(24)</sup> However in the absence of practical, pragmatic research which directly address this question it is difficult to make a recommendation.

### **CONCLUSION**

Hypotension during spinal anesthesia remains one of the most researched subjects in obstetric anesthesia. Good quality research has outlined the mechanism, described the hemodynamic changes and refined the management of OSH. However, these researches and the resulting guidelines from these investigation, to treat OSH are from resource-rich clinical settings. This has led to a gap between this knowledge base and its implementation in real-world settings outside the research environment. The issue of spinal hypotension may not be that of a severe nature in resource-rich environment but it is responsible for high maternal mortality in resource-poor area which constitutes more than 75% of the world's population. The most appropriate solution is to have innovative, collaborative research, starting in academic centers, and applying the findings in the context of limited-resource environments.

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