

# Blood Pressure Management Controversies in Neurocritical Care



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## KEYWORDS

• Neurocritical care • Blood pressure • Monitoring • Treatment

## KEY POINTS

- Blood pressure (BP) management is essential in neurocritical care settings to ensure adequate cerebral perfusion and prevent secondary brain injury. However, significant practice variations persist regarding optimal methods for monitoring and treatment of BP values among critically ill patients with neurologic injuries.
- Controversies in management include identifying optimal methods for BP monitoring and treatment. Monitoring centers on how BP is measured and recorded, whereas treatment includes use of pharmacologic agents.
- Although there is little research evidence and few recommendations to guide monitoring and treatment decisions in neurocritical care, preliminary studies support the need for ongoing research efforts. Technological advances in neurocritical care may also address aspects of controversies by providing solutions to overcome limitations of various management approaches.

## INTRODUCTION

Blood pressure (BP) management is a mainstay of treatment of neurocritically ill patients. Management includes methods for monitoring BP, as well as treatment approaches to keep pressures within set parameters. Optimization of BP to ensure accordance with prescribed parameters is important for cerebral perfusion, oxygenation, and prevention of secondary brain injury. Primary injury to the brain results from hemorrhage caused by trauma, stroke, or aneurysm rupture, or ischemic events such as stroke or hypoxic episodes.<sup>1</sup> Secondary brain injury occurs in the

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hours and days after the initial injury and is caused by complex biochemical and physiologic responses to the initial injury, such as cellular excitotoxicity, free radical production, electrolyte shifts, inflammation, and ischemia.<sup>1</sup> Cerebral autoregulation in the vasculature of the brain maintains constant cerebral blood flow independently of systemic factors. However, autoregulatory mechanisms in neurocritically ill patients are often impaired by primary and secondary brain injuries. Therefore, diligent management of systemic BP becomes critical to ensure adequate cerebral perfusion.

Although there is consensus that BP management is an important element of neurocritical care, significant variations persist among practitioners and institutions with regard to how BP is monitored and treated.<sup>2-4</sup> Variations are caused by differences in training, fragmented research efforts, and lack of definitive practice recommendations for specific aspects of BP management among neurocritically ill patients. Variations in practice highlight the need for an evidence-based review to move toward a systematic and standardized approach to BP management. Therefore, this article highlights management controversies for BP control in neurocritical care, and presents an evidence-based review of current practices for both monitoring and treatment.

### **CONTROVERSIES IN MONITORING: NONINVASIVE OR INVASIVE BLOOD PRESSURE MEASUREMENT**

The initial step in identifying optimal approaches for BP management in neurocritical care is to identify the most effective approach for monitoring BP. A key controversy is whether noninvasive monitoring is comparable with invasive arterial monitoring when trending and recording BP in neurocritically ill patients. The most common noninvasive BP monitoring includes aneroid (mercury), and oscillometric (automated) BP measurement that is obtained via noninvasive cuffs.

Aneroid methods were established in the mid to late 1800s with the creation of the mercury monometer. Adaptations of the device and development of the sphygmograph throughout the 1800s resulted in a BP armband that is similar to what is still used for noninvasive manual BP monitoring.<sup>5</sup> In 1905, Korotkoff established the gold standard of measuring noninvasive BP with an armband, referred to as the manual auscultatory technique. The technique has 5 phases and involves inflating a cuff on the proximal arm, auscultating for phase I, which is a tapping sound and reflects systolic pressure. The diastolic pressure is determined by the disappearance of muffled sounds of phase IV. Although this technique is considered to be the gold standard for noninvasive measurements, it has limitations, such as human error when identifying auscultated sounds, cuff size error, and lack of continuous or ongoing measurements.<sup>6</sup>

In contrast with the manual approach for BP measurement, oscillometric BP measurement was established in 1885 with the use of sensors to detect oscillations in BP.<sup>5</sup> The oscillometric technique was developed before Korotkoff's auscultation method and continues to be used in current automated noninvasive BP equipment. Automated oscillometric cuffed equipment inflates to a pressure greater than systolic pressure and slowly deflates while sensors oscillate to determine resistance or pressure. The mean pressure is detected at the maximal oscillation when the artery is most compliant, and the systolic and diastolic pressures are then calculated by the equipment. Automated cuffs can be set to repeat at determined intervals but are inaccurate at intervals less than 30 seconds. As with other noninvasive techniques, there are limitations with this approach that center on human error, cuff sizing, lack of continuous

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