Review Article
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Exploring the Role of Bispectral Index in Interrupting CPR for ROSC Diagnosis: A Call for Further Research

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Abstract

The current approach in cardiopulmonary resuscitation (CPR) involves interrupting the chest compressions to assess the pulse and diagnose Return of Spontaneous Circulation (ROSC). This critical step is essential for determining the effectiveness of resuscitation efforts. However, the interruption of CPR poses a challenge, prompting researchers to explore alternative methods for diagnosing ROSC without compromising the ongoing resuscitation process.

One potential solution proposed in the literature is the use of the Bispectral Index (BIS). BIS is a numerical value derived from processed electroencephalogram data, providing a measure of the depth of anesthesia or sedation. Some studies have reported an increase in BIS values following successful ROSC during CPR. This observation suggests that monitoring BIS levels could offer real-time information about cerebral perfusion and neurological status, eliminating the need for pulse checks that require CPR interruption.

Despite these promising indications, it is crucial to acknowledge the limited existing literature on the subject. The evidence supporting the use of BIS in diagnosing ROSC during CPR is not yet robust, and further research is warranted. Researchers are encouraged to delve into this unexplored area, conducting comprehensive studies to assess the reliability and effectiveness of BIS as a tool for continuous monitoring during resuscitation efforts.

In conclusion, while the concept of using BIS to diagnose ROSC during CPR holds potential, it remains an area that requires substantial research attention. The limited existing literature underscores the need for more extensive investigations to determine the feasibility and reliability of integrating BIS into the CPR protocol. As technology advances, exploring innovative approaches for continuous assessment during resuscitation becomes imperative for improving outcomes in cardiac arrest scenarios.

Keywords: Cardiopulmonary resuscitation, Return of Spontaneous Circulation, Bispectral Index, Pulse checks, Cerebral perfusion, Neurological status, Resuscitation monitoring, Continuous assessment, Resuscitation outcomes.

Cardiopulmonary resuscitation

Cardiopulmonary resuscitation (CPR) is the immediate and critical response to cardiopulmonary arrest. The primary goal of CPR is to maintain a minimal level of blood flow to vital organs, particularly the brain, until the normal heart rhythm can be restored. This is achieved through a combination of chest compressions and rescue breaths. The American Heart Association and other relevant medical organizations provide guidelines for the correct application of CPR techniques (1). In the event of witnessing someone experiencing cardiopulmonary arrest, the first step is to call for emergency medical assistance. Simultaneously, the initiation of chest compressions is crucial. Chest compressions help circulate oxygenated blood throughout the body, sustaining essential organ function (2). Additionally, rescue breaths, which involve providing breaths to the patient, play a role in delivering oxygen to the lungs. This is especially important because the interruption of normal breathing is a hallmark of cardiopulmonary arrest. The combination of chest compressions and rescue breaths constitutes basic life support (BLS) and is vital in maintaining oxygen supply to the body's tissues (3).

Alongside CPR, advanced cardiac life support (ACLS) may be required, involving interventions such as defibrillation, administration of medications, and airway management. Defibrillation, the delivery of an electrical shock to the heart, is particularly effective in restoring a normal heart rhythm, especially in cases of ventricular fibrillation (4). Return of spontaneous circulation (ROSC) is the ultimate objective in cardiopulmonary resuscitation. ROSC occurs when the heart regains an effective and sustainable rhythm, leading to the restoration of spontaneous blood circulation. Achieving ROSC is a critical milestone as it indicates that the interventions have been successful in reviving the patient (5). The chances of achieving ROSC are significantly influenced by the timeliness and effectiveness of the interventions. Early initiation of CPR,

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prompt defibrillation, and coordinated advanced life support measures substantially increase the likelihood of ROSC. However, even with successful ROSC, the underlying cause of the cardiac arrest must be identified and addressed to prevent a recurrence (4,5).

Healthcare providers use various methods to assess ROSC. One primary indicator is the presence of a palpable pulse, indicating that the heart is pumping blood effectively. The assessment of adequate blood pressure and spontaneous, purposeful movements also contributes to confirming ROSC. Additionally, the return of spontaneous breathing is a crucial sign that the patient is regaining autonomous respiratory function (6). Technological aids, such as cardiac monitoring and capnography, are valuable in the ROSC evaluation process. ECG monitoring helps healthcare providers observe the heart's electrical activity, confirming the reestablishment of a coordinated rhythm. Capnography, which measures exhaled carbon dioxide, provides an indirect but reliable indicator of cardiac output, aiding in the assessment of circulatory status (7,8).

Despite these indicators, it's important for healthcare providers to remain vigilant, as certain factors may mimic signs of ROSC without genuine circulation restoration. Therefore, a comprehensive and multifaceted approach, incorporating both clinical and technological assessments, is essential in accurately determining ROSC and guiding further interventions (9).

Regular reassessment is crucial, as the patient's condition can change rapidly. Continuous monitoring, along with adherence to established protocols, ensures that any deterioration or recurrence of cardiac arrest is promptly addressed. Overall, the thorough evaluation of ROSC is integral to the post-resuscitation care process, influencing subsequent treatment decisions and the overall prognosis of the individual who has undergone cardiac arrest (10).

Bispectral Index

Bispectral Index (BIS) is a numerical value that quantifies the depth of anesthesia by analyzing electroencephalographic (EEG) signals. It is a crucial monitoring tool in anesthesia management, providing real-time feedback on a patient's level of consciousness during surgical procedures (11). The BIS is derived from the analysis of the patient's EEG, which reflects the electrical activity of the brain. By processing this EEG data, the BIS produces a numerical value between 0 and 100, where lower values indicate a deeper level of anesthesia and higher values suggest increased consciousness. This information helps anesthesiologists and healthcare providers optimize anesthesia administration, tailoring it to the patient's individual needs (12).

The advantages of using BIS include its ability to minimize the risk of awareness during surgery, optimize drug dosages to prevent over-sedation or inadequate anesthesia, and enhance the overall safety of the anesthesia process. BIS monitoring is particularly valuable in surgeries where precise control of the depth of anesthesia is critical, such as cardiac procedures or neurosurgery (13). Healthcare providers interpret the BIS values in conjunction with other clinical signs to ensure comprehensive patient care. While BIS is a valuable tool, it is essential to consider other factors, such as the patient's response to stimuli and vital signs, for a complete assessment (14).

Bispectral Index and Return of Spontaneous Circulation

During cardiac arrest or CPR situations, the focus is usually on restoring the patient's cardiac functions and supporting vital functions. Therefore, other types of monitoring and assessment tools are typically employed in these emergency situations. The primary focus during CPR includes actions such as chest compressions, respiratory support, and defibrillation.

However, in post-cardiac arrest situations where the patient has achieved ROSC and the condition stabilizes, monitoring tools like BIS may be used in later stages of treatment for assessing consciousness and controlling the depth of anesthesia.

In their case study, Azim and Wang demonstrated that BIS monitoring showed a parallel decline with blood pressure before cardiac arrest, reaching zero, and subsequently increasing during CPR, highlighting its potential use in assessing cerebral perfusion dynamics in cardiopulmonary arrest (15). In another case presentation of a patient experiencing arrest in the emergency department, it was reported that the patient's BIS value increased from the moment ROSC was achieved (16). In the case presentation by Chakravarthy et al., BIS monitoring was concluded to be an additional tool to confirm the adequacy of CPR. A BIS value of approximately 40 was generally established as the desired level, requiring efforts not only to achieve an adequate mean arterial pressure but also emphasizing that low BIS values should not be considered as a sole reason to terminate CPR (17). In the case presentation involving two patients by Nitzschke et al., they argued that numerical processed parameters such as BIS and Patient State Index, derived during CPR based on EEG recordings, would be affected by artifacts from chest compressions, rendering them incapable of providing useful information regarding the adequacy of cerebral oxygenation during CPR (18). In Shibata et al.'s study, BIS monitoring was conducted on 10 patients admitted to the intensive care unit after experiencing sudden cardiac death with successful ROSC. The average BIS values of four patients who achieved positive neurological outcomes reached >80 within the first 30 minutes after admission. In contrast, patients who did not survive after ROSC attained only an average BIS of 9.7(19). In Liu et al.'s study, BIS monitoring was conducted on patients who received cerebral protective treatment after ROSC. In the surviving group, the BIS values were significantly higher compared to the group that resulted in death. Additionally, a positive correlation was observed between Glasgow Coma Scale and BIS (20). In Çetinkaya Ünal›s study, when examining the correlation between the elapsed time during CPR and the BIS value, a negative correlation was observed. similarly, when investigating the correlation with the duration and signal complexity index value, a positive correlation was noted (21). This indicates that as time passes, the BIS value tends to decrease.

As a result, we interrupt CPR to assess the pulse for diagnosing ROSC during CPR. BIS could be a suggestion to address the issue of interrupting CPR; however, the existing literature is not sufficient to establish this. Researchers should be encouraged to delve into this matter.

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