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Commentary

Automation Control Techniques for Intravenous Anesthesia

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DESCRIPTION

Oliver Holmes suggested using the word "anaesthesia" to describe the lack of sedation during surgery. Anesthesia's primary goals during surgery are to induce unconsciousness, offer pain relief, relax the muscles, and maintain vital signs. Clinical anaesthesia is a pharmacological condition that balances hypnosis, analgesia, and muscular relaxation. By controlling the doses of various anaesthetic medicines, anesthesiologists are able to keep the patient's vital signs and desired level of anaesthesia within a safe range even during surgical stimulation. The fast infusion of anaesthetic medications with ongoing vigilance over any adverse effects, as well as any divergences with other medical drug treatments to preserve the patient's vital signs, is under the purview of the anesthesiologist. Hypnosis is used to describe states of unconsciousness, suppress recall of intraoperative and postoperative events, and lower the body's stress reaction. Body stress and unpleasant experiences may result from this intraoperative consciousness. Hypnosis modulation prevents these negative effects.

Due to the strong correlation between brain activity and unconsciousness, the hypnotic reaction can be read from the EEG signal. The EEG potential evoked, entropy of EEG signal, and bi-spectral index are the two most widely used indicators of unconsciousness (BIS). There are short summaries of EEG parameters used in anaesthesia in the literature. Propofol (a hypnotic anaesthetic agent) medication administration in manual mode is entirely dependent on the anesthesiologist's clinical expertise and experience. Various anesthesiologists may alter the dosage and overall drug intake. Propofol overdosing can result in hypotension, a protracted recovery period, ileus, nausea, and immunosuppression. Inadequate propofol dosage might cause blood pressure instability and cardiovascular collapse. Under sedation, however, can result in tachycardia, agitation, and anxiety. Propofol infusion must therefore be managed carefully during surgery. As a result, the medication dose variation across various anesthesiologists can be optimised using a closed loop propofol infusion management technique. Automation plays a crucial part in anaesthesia by lightening the anesthesiologist's workload and giving them more time to deal with crucial components of surgery. The primary feedback signal for the automated infusion of propofol during surgery is often BIS. The automatic propofol infusion system has the capability to maintain a decent degree of attentiveness and a sufficient Depth of Anaesthesia (DOA) throughout surgery. Additionally, the number of critical occurrences, patient danger, and insufficient drug dosage will be decreased with the help of a closed-loop automatic control system and combined anesthesiologist monitoring.

CONCLUSION

Compared to manual control system-based drug titration, the closed-loop hypnotic control scheme performs better in terms of post-operative recovery, stable vital signs, and controlled variable stability. Due to the increased use of anaesthetic medicines during surgery, the closed-loop hypnotic control strategy lowers post-operative care, clinical costs, and adverse effects both during and after surgery. The goal of developing the automatic infusion control system for anaesthetic medications is to maintain the anaesthetic level based on the needs of the patient's body, which depends on the following factors;

- Compared to manual administration methods, automatic medication infusion technology performs better in terms of controlling pharmacological variability. The automatic propofol infusion technique allows for more frequent sampling of the regulated variables than the manual control.
- With high quality, anaesthesia automation can accomplish a number of goals, such as maintaining the upper and lower medication infusion constraints and following the reference BIS signal.
- Patient variability can be managed with proper control strategy design and the fault tolerance module. To increase patient safety against sensor and actuator failure conditions during surgery, a system's fault tolerance capability is crucial.
- A control scheme with a well design can deliver medication doses according on the needs of the patient's body. Automatic medication infusion control systems reduce drug consumption, unfavourable effects, and intraoperative arousal issues while operating and speed up postoperative recovery, which lowers medical costs and postoperative care costs. Overall, these elements enhance patient physical health and safety both before and following surgery.