

## Monitored anesthesia care: An overview

Monitored anesthesia care (MAC) has been described as a specific anesthesia service for diagnostic or therapeutic procedures performed under local anesthesia along with sedation and analgesia, titrated to a level that preserves spontaneous breathing and airway reflexes, according to the latest American Society of Anesthesiologists (ASA) update in 2008.<sup>[1]</sup> MAC alone or with local anesthesia accounts for a relatively high percentage of anesthesia services nationwide. MAC essentially comprises of three basic components: A safe conscious sedation, measures to allay patient's anxiety, and effective pain control.<sup>[2]</sup> This service (MAC) results in less physiologic disturbance and a more rapid recovery than general anesthesia. MAC is suitable for day care procedures as it helps in fast tracking. Presently, MAC is the first choice in 10-30% of all surgical procedures.<sup>[2]</sup>

A provider of MAC has to be qualified and skilled to rescue an airway or convert to general anesthesia if the situation demands. Hence, MAC is essentially an anesthesiologist led service.

The standard of care is essentially the same as that for general or regional anesthesia, and includes a proper preanesthetic checkup, standard intraoperative monitoring, and routine postoperative care. An obvious difference exists between MAC and moderate sedation. MAC includes support of vital functions, management of possible intraoperative problems, and provision of psychological support. Monitoring comprises of continuous communication with the patient, observation of parameters such as oxygenation, ventilation, circulation, temperature, as well as vigilance for local anesthesia toxicity. Capnography is an essential monitoring component of MAC to detect apnea at an earliest opportunity.

Sedation is a continuum, which ranges from minimal (anxiolysis), to moderate (also called conscious sedation, where the patient remain asleep but is easily arousable), to deep sedation (where the patient can be aroused only by painful stimuli). Assessment of the depth of sedation is of

great importance as it helps in titrating drug administration to prevent awareness or excessive anesthetic depth and thereby promotes patient safety and early recovery. The bispectral index (BIS) is effective to measure the depth of consciousness during MAC. The incidence of apnea during MAC is high, and the incidence increases as BIS decreases.<sup>[3]</sup> There is a poor correlation between BIS value and observational sedation scale scores for different sedative drugs,<sup>[4]</sup> which emphasizes the use of both BIS and sedative scales to evaluate patient's response to sedation.

An ideal sedative agent should be consistently effective in having rapid onset, easy titration, high clearance, and minimal side-effects; particularly a lack of cardiovascular and respiratory depression. Due to dearth of an ideal agent, sedation techniques for MAC often utilizes a combination of agents to provide analgesia, amnesia, and hypnosis with complete and rapid recovery that suits a particular operative procedure with minimum side effects like postoperative nausea and vomiting (PONV), prolonged sedation, and cardiorespiratory depression.

Operation time, clinical condition, age of the patient, and the need to convert to general or regional anesthesia; help to guide towards the selection of appropriate sedation technique. Fewer sedative drugs are required in geriatric population, as chances of desaturation and cardiovascular instability are more.<sup>[5]</sup> Apart from the distribution and elimination half-life, factors like context sensitive half-time, effect-site equilibration, and potential of interaction with other drugs need to be taken into account while choosing the drugs. Targeting the effect-site concentration rather than blood concentration provides faster onset and better predictability of drug effect. Drug titratability can be achieved with the use of a wide variety of drug delivery techniques including intermittent boluses, target-controlled infusion, variable-rate infusion, and patient-controlled sedation (PCS). The patient-maintained sedation (PMS) is found to be more effective than PCS in terms of patient satisfaction and minimizing side effect.<sup>[6]</sup>

Low-dose ketamine provides weak sedation but excellent analgesia. It has a positive effect on hemodynamic stability and can counteract the propofol-induced respiratory depression. Emergence delirium is usually not reported at lower doses. It causes a higher incidence of PONV and the offset is prolonged with higher dosage. Combining midazolam or propofol with ketamine reduces PONV, but increases the respiratory adverse events. One study identified adverse events in 17% of pediatric patients receiving procedural sedation. Fortunately,

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most of the adverse events are self-limiting or easily controlled, indicating reasonable level of safety.<sup>[7]</sup> Propofol has a short context-sensitive half-time even after prolonged infusions, and thus produces clear headed recovery. Moreover, propofol reduces the chance of PONV, but it does not reliably produce amnesia in lower doses. Midazolam has a short elimination half-time and produces adequate amnesia. However it causes prolonged psychomotor impairment when used alone. The midazolam-opioid combination displays synergism not only in providing hypnosis but also to produce severe respiratory as well as cardiac depression. A study evaluating the respiratory effects of midazolam (0.05 mg/kg) and fentanyl (2.0 µg/kg) in volunteers found that this combination produces a potent drug interaction that places patients at a high risk for hypoxemia and apnea.<sup>[8]</sup> In a recent Cochrane review involving 510 patients posted for endoscopic retrograde cholangiopancreatogram (ERCP) procedure, a comparison between propofol and opioid midazolam combination was reviewed. The recovery of patients who were administered propofol was better and faster. The safety profile was same in either of the techniques.<sup>[9]</sup> A systematic review on the safety and efficacy of various forms of analgesia and sedation used for fracture reduction in pediatric population revealed that ketamine-midazolam combination is more effective with lesser adverse effects than midazolam-fentanyl or propofol-fentanyl combination.<sup>[10]</sup>

Dexmedetomidine, a novel alpha-2 adrenergic receptor agonist, provides adequate sedation and analgesia with minimal respiratory depression. It acts primarily on the sleep pathway and does not inhibit the activity of the orexinergic neurons, which is the basis of its arousable sedation.<sup>[11]</sup> Moreover it has sympatholytic action which not only decreases the stress response to surgery but also the surges in heart rate and blood pressure. The hypnotic sedative effects of dexmedetomidine can be easily reversed with alpha-2 adrenergic receptor antagonist atipamezole which may help to produce a titratable form of sedation.

Parikh DA and colleagues studied the effect of the newer drug dexmedetomidine against the traditional midazolam-fentanyl combination for providing adequate sedation and analgesia in tympanoplasty operation under MAC. They found a higher patient and surgeon satisfaction with dexmedetomidine indicating a qualitatively better sedation profile but there were significant falls in heart rate and blood pressure warranting close monitoring. The recovery pattern for both the drugs was not observed in this study. Dexmedetomidine showed no significant advantage over midazolam-fentanyl in terms of respiratory depression, there being no incidence of bradypnea in either of the groups.<sup>[12]</sup>

A multicentric trial on 321 patients undergoing a broad range of surgical or diagnostic procedures under MAC revealed that dexmedetomidine provides greater patient satisfaction, less opioid requirements, and less respiratory depression than placebo rescue with

midazolam and fentanyl.<sup>[13]</sup> Dexmedetomidine was well-tolerated over different age groups and the hypotension and bradycardia caused by its infusion were easily manageable. Dexmedetomidine with fentanyl has been used safely and effectively for sedation and analgesia during extracorporeal shockwave lithotripsy.<sup>[14]</sup> Thus despite higher cost, dexmedetomidine appears to be an attractive alternative and effective substitute of opioids, primarily due to its property of arousable sedation with analgesic sparing effect, preservation of better airway reflexes, and ventilatory drive. There is further scope of research to evaluate the minimal necessary dose requirement in different age groups, sex, and races.

Contrary to the popular belief, intravenous sedatives may actually increase the pain perception during procedural sedation. Frölich MA *et al.*, concluded that the pain perception during procedural sedation not only depends on the type of sedative administered but also the gender and race of the patient.<sup>[15]</sup> This knowledge may actually help to guide us to provide analgesia and sedation to facilitate medical procedures.

There is a growing attention worldwide on health reforms and allocation of limited healthcare resources in all aspects of medical practice. MAC is no exception to that. All efforts are made to maintain parity between quality, efficiency, and affordability. The ever rising cost of MAC is also an issue of concern and we should weigh the accrued benefits against the increased cost involved. Perhaps we need to prioritize the patients who are the right candidates for MAC. Till now, there is paucity of comprehensive evidence to suggest a particular technique as best. Future research comparing different sedation techniques, particularly in pediatric and geriatric population may reveal our answer.

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