Target Controlled Inhalational Anesthestia- Isoflurane Consumption with Adequacy of Anesthesia Monitoring in Conventional and Multimodal Analgesia: A Comparative Study

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Background: In this era of increased concern over environmental impact of chlorofluorocarbons, there is an impetus to minimize inhalational anesthetic consumption. This is possible with the practice of low flow anesthesia (LFA)[1,2] and multimodal analgesia (MMA)[3,4] techniques.

LFA is a closed system in which the fresh gas flow is 500-1000 ml/min.[2] It can be administered either by manually controlled anesthesia (MCA) or target controlled anesthesia, also known as end–tidal control anesthesia (EtCA). In MCA, the set target of end tidal oxygen and anesthetic gases are titrated by the anesthesiologists whereas in EtCA it is automatically adjusted by newer anesthesia work stations (GE Healthcare Aisys CS2). [5]

Even though LFA minimizes operation theater pollution, the gases vented out by the scavenging system has an impact on greenhouse gas emission[1] which could be minimized by practicing MMA, a rational approach to treat acute pain. In MMA, all four elements of pain processing, namely, transduction, transmission, modulation and perception, are targeted with specific drugs, whereas in conventional analgesic regimen (CAR) only one or two elements are targeted.[3]

During the conduct of tailor-made balanced anesthesia, patient monitoring with Adequacy of Anesthesia (AoA) concept is deemed appropriate by the anesthesiologist in order to minimize adverse events. An advanced non-invasive monitoring technology provides balanced view of the derived parameters: depth of amnesia, analgesia and muscle relaxation by Spectral Entropy (SE), Surgical Pleth Index (SPI) and frontal electromyography (FEMG) signals respectively.[6]

We aimed to assess the difference in isoflurane consumption between MMA and CAR for a given period of time using EtCA and AoA monitoring. We hypothesized that MMA using EtCA would significantly reduce the intraoperative isoflurane consumption.

Methods: A prospective randomized double blind study was conducted after obtaining approval from the Hospital Ethics Committee. After obtaining informed consent, 60 patients under ASA physical status I and II undergoing laparoscopic cholecystectomy were included. They were divided into study group (MMA group) and control group (CAR group). In the induction room, patients were attached with monitoring devices along with entropy leads. Both groups received 2% xyloadrenaline infiltration at the entry ports along with pre-emptive diclofenac sodium 75gm intravenously. In addition, the MMA group received intravenous acetaminophen 1gm and clonidine 0.75µg/kg. All patients were premedicated with intravenous midazolam 0.03mg/kg, ondansetron 4mg, glycopyrrolate 0.2mg and fentanyl 3µg/kg. They were then induced with propofol and paralyzed with atracurium 0.5mg/kg. Anesthesia was maintained with isoflurane in air and 30% oxygen along with atracurium. When inspired and expired minimum alveolar concentration of isoflurane was equilibrated, the mode was

switched over to EtCA. AoA was used to monitor the depth of balanced anesthesia (SE: 35-45, SPI: 30-40). The consumption of isoflurane and duration of anesthesia were documented before extubation. Patient was extubated when TOF T4/T1 ratio ≥0.9 and AoA Bal view in court 4 or 1 (Fig-1). Adverse effects of analgesic drugs were noted. Statistical significance of mean difference between the two groups was analyzed using Independent t-test. $p<0.05$ was considered statistically significant.

Results: Mean isoflurane consumption in MMA group was 8.9±4.1ml whereas in CAR group it was 12.7±5.3ml (p=0.002). Duration of anesthesia between the groups was not clinically significant (p=0.931). None of the patients had awareness under general anesthesia.

Conclusion: MMA with EtCA significantly reduces isoflurane consumption due to inhibition of nociception at all levels of pain processing along with its synergistic effect with isoflurane.

References:

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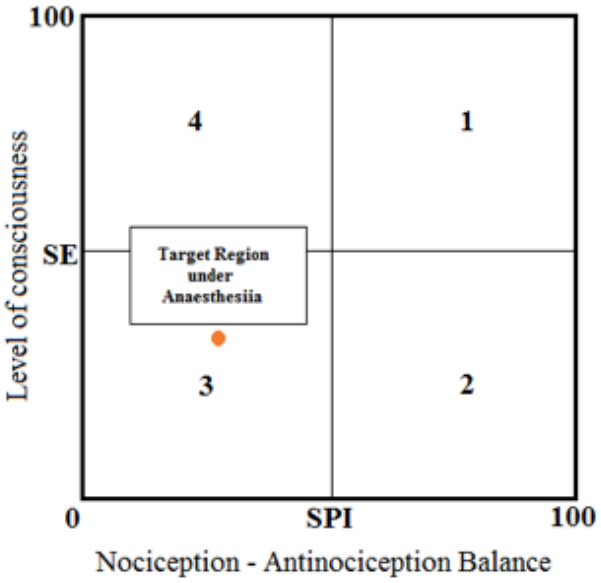

Fig-1: AoA split screen view.

SE (State entropy) Normal range 40-60, Deep anesthesia <40, needs adjusted titration >60.
SPI (Surgical pleth index) Normal range 25-50, Intense analgesia <25, Inadequate analgesia >50.
AoA Bal view indicates depth of analgesia and amnesia. Dot in court-1: patient is awake, court-2: adequately sedated but analgesia inadequate, court-3: towards center surgical plane and towards zero very deep plane, court-4: adequate analgesia in light plane of anesthesia.