

MONITORED ANESTHESIA CARE (MAC)

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The advent and popularity of ambulatory or outpatient surgery has promoted the concept of Monitored Anesthesia Care (MAC). This technique is similarly referred to as local anesthesia with standby, or simply "standby anesthesia".

The American Society of Anesthesiologists (ASA) defines MAC as "instances in which an anesthesiologist has been called upon to provide specific anesthesia services to a particular patient undergoing a planned procedure, in conjunction with which a patient receives local anesthesia or, in some cases, no anesthesia at all. In such a case, the anesthesiologist is providing specific services to the patient and is in control of the patient's non-surgical or non-obstetrical medical care, including the responsibility of monitoring vital signs, and is available to administer anesthetics or provide other medical care as appropriate."

It is also the policy of the ASA that all of the usual services performed by the anesthesiologist should be furnished, including but not limited to, the usual noninvasive cardio-circulatory and respiratory monitoring, as well as administration of oxygen when indicated. In addition, the intravenous administration of sedatives, tranquilizers, antiemetics, analgesics, B-blockers, vasopressors, bronchodilators, antihypertensives, or other pharmacologic therapy may be required, as deemed necessary by the anesthesiologist.

MAC is differentiated clinically from regional anesthesia such as epidural or spinal, and general anesthesia. (Table 1) General anesthesia is defined as a state characterized by unconsciousness, analgesia, muscle relaxation and depression of reflexes. The primary objective in providing

Table 1.

CONSCIOUS SEDATION VERSUS UNCONSCIOUS SEDATION

<u>Conscious Sedation</u>	<u>Deep (Unconscious) Sedation</u>
Mood altered	Patient unconscious
Patient cooperative	Patient unable to cooperate
Protective reflexes intact	Protective reflexes obtunded
Vital signs stable	Vital signs labile
Local anesthesia provides analgesia	Pain eliminated centrally
Amnesia may be present	Amnesia always present
Short recovery room stay	Occasional prolonged recovery room stay or overnight admission required
Low risk of complications	Higher risk of complications
Postoperative complications infrequent	Postoperative complications reported in 25-75% of cases
Uncooperative or mentally handicapped patient cannot be managed	Useful in managing difficult or mentally handicapped patients

MAC is to ensure patient comfort and safety during operations under local anesthesia. This is achieved by carefully monitoring vital signs and by providing analgesia, amnesia, and sedation, without compromising cardiorespiratory function, or delaying recovery. The attractiveness of MAC in the outpatient setting includes more rapid

patient turnover time and recovery, and fewer anesthetic side effects such as nausea and vomiting. Outpatient elective foot and ankle surgical procedures rely heavily on monitored anesthesia care due to its decreased morbidity and minimally invasive nature. MAC is also useful in selected lower extremity trauma cases where the patient may have recently eaten and is not a candidate for a general anesthetic.

Many patients are reluctant to undergo local anesthesia without supplemental medication because they are concerned about pain and awareness during surgery. Therefore, the anesthesiologist may administer centrally active drugs that serve as adjuvants to the local anesthetic agents. These drugs are predominantly the sedative-analgesics. Sedation is frequently desirable during local anaesthesia to produce amnesia and analgesia, and to enhance patient comfort during the procedure. Drugs may be administered pre-, intra-, or postoperatively through a variety of routes.

The benzodiazepines such as midazolam, diazepam and temazepam are very useful for producing amnesia, anxiolysis and sedation. Analgesic medications are frequently combined with the benzodiazepines for patient comfort. The concomitant use of potent opioid analgesics, such as Fentanyl can cause profound ventilatory depression. Recommendations in these situations include continuous monitoring of respiration and the use of supplemental oxygen. Probably the greatest danger in MAC is a lack of vigilance because a "minor" surgical procedure is being performed. The importance of adequate and attentive monitoring is every bit as important as with a regional or general anesthetic.

Critical to the understanding and utilization of MAC is the level of sedation. The amount of sedation lies on a dose-dependant continuum from minimal sedation to general anesthesia. Under "conscious sedation" the patient must be capable of rational response to commands, and able to maintain airway patency. The imperative factor with conscious sedation is that it will not alter cardiac, respiratory, or reflex function to the extent of requiring external support.

Scamman et al. have outlined the objectives of conscious sedation as relieving anxiety and producing amnesia. These goals are accomplished by means of good preoperative communication

and instruction, low levels of visual and auditory stimuli in the operating room, and maintenance of patient warmth and covering. Relief from pain and other noxious stimuli must be provided. Opioid analgesics are given to supplement local or topical anesthetics, and to block pain sensations remote from the operative site. Adequate sedation must be achieved with minimal risk. Sedative medication should not interfere with the patient's ability to communicate verbally, and the usual monitoring devices and emergency systems must be available.

As with other types of anesthesia, the optimal level of care during MAC is achieved by meticulous attention to detail. This is of particular importance when multiple sedative-analgesic drugs are being used, and in the care of patients with clinical or laboratory findings that may reflect poor cardiovascular, respiratory or other systemic compromise. The ASA specifies that patient oxygenation, ventilation, circulation and temperature must be continually evaluated. Further ASA recommendations for the provision of monitored anesthesia care include the following: *Inspired gas:* During every administration of general anesthesia using an anesthesia machine, the concentration of oxygen in the patient breathing system shall be measured by an oxygen analyzer, with a low oxygen concentration alarm in use. *Blood oxygenation:* During all anesthetics, adequate illumination and exposure of the patient are necessary to assess color. Although this and other qualitative clinical signs may be adequate, there are quantitative methods (e.g., pulse oximetry) which are encouraged. *Ventilation:* During monitored anesthesia care, the adequacy of ventilation shall be evaluated, at least, by continual observation of qualitative clinical signs (e.g., respiratory rate). *Circulation:* Every patient receiving anesthesia shall have an electrocardiogram continuously displayed from the beginning of anesthesia until preparation to leave the anesthetizing location. *Body temperature:* There shall be readily available a means to continuously measure the patient's temperature.

These recommendations are for minimum monitoring and may be inadequate in some situations. The appropriate selection and usage of monitoring devices should be based on the anesthesiologist's judgment. Additional requirements may be dictated by the patient's medical condi-

tion, the anesthetic and analgesics used and the surgical procedure itself. Monitoring mechanisms used during MAC should be noninvasive, manageable and effective. The monitors of choice for MAC are noninvasive since most surgical procedures for which MAC is utilized involve minimal physiological stress. This is certainly the case with the majority of elective foot and ankle surgery.

Monitoring must include the ongoing evaluation of both the desired effects and side effects of all drugs administered. Specific monitoring requirements for MAC range from establishing a good rapport with the patient to individual system monitoring. To be effective during MAC, the anesthesiologist must remain in close verbal and/or tactile contact with the patient, particularly when centrally active drugs that may produce cardiorespiratory depression are administered. Communication with the patient facilitates the evaluation process and intraoperative management of the case. Specific physiological system monitoring may be divided into primarily respiratory and circulatory. Respiratory monitoring is essential due to the risk of hypoxemia during sedative anesthesia, especially with the combination of sedatives and narcotics. Since varying degrees of respiratory depression are expected during MAC, supplemental oxygen should be given. Specific monitoring begins with clinical observation of respiration pattern, rate and tidal volume. Careful observation for airway maintenance, hypoventilation and regurgitation is essential. The stethoscope is of obvious importance for evaluation of heart tones and breath sounds. Pulse oximetry is considered mandatory by most anesthesiologists for any anesthetic procedure, and certainly for monitored anesthesia care. It is sensitive, reliable, and provides an early warning of any impending desaturation prior to the development of clinical hypoxemia.

Circulatory monitoring is likewise performed by clinical observation of peripheral perfusion by skin color and capillary refill. Arterial pulse monitoring for quality, rate and regularity is necessary although pulse oximetry offers some overlap in this assessment. Arterial blood pressure monitoring and electrocardiogram serve as adjuncts to cardiovascular assessment. The primary role of the ECG during MAC is to serve as a detector of

arrhythmia and as a warning of myocardial ischemia. Temperature monitoring during MAC is beneficial as the most likely temperature derangement is inadvertent hypothermia. The main focus of temperature monitoring should be to prevent hypothermia and the resultant shivering, which can become uncomfortable and may cause increased oxygen consumption, interfere with the surgery, and increase pain at the operative site. It is also important for the detection of malignant hyperthermia, a serious although rare complication of anesthesia. Central nervous system monitoring is a mainstay in assessing the efficacy of MAC. The primary benefit is in evaluation of whether adjunctive drugs have achieved the desired degree of analgesia, sedation, anxiolysis, and overall patient comfort.

A thorough familiarity with recovery room monitoring and discharge criteria is mandatory for any physician performing outpatient or ambulatory surgery. Recovery room monitoring after MAC is a natural extension of intraoperative monitoring, with particular emphasis on respiratory adequacy, cardiovascular stability and return to basal cerebral function. This also includes regular clinical evaluation as well as the use of pulse oximetry, blood pressure, and temperature monitoring. The principal aims in the recovery room are to assess the residual effect of drugs administered intraoperatively and determine when the patient is fit for discharge. The predominant criteria for discharge from the recovery room and subsequently the outpatient department are contingent upon the post-anesthesia score and postoperative score, respectively. Continuous reassessment at timed intervals serves as a standardized criteria for discharge. In general, most anesthesiology departments require a score of 8 or greater for discharge from the post anesthesia care unit or outpatient center. (Tables 2,3)

A general overview of the elements of quality monitored anesthesia care (MAC) as an anesthetic technique is presented. As the predominance of foot and ankle surgery is now performed on an outpatient or ambulatory basis, it is important for the surgeon to have a thorough understanding of these concepts. All physicians should be familiar with the general anesthesiology discharge criteria for a patient and its value in assessing the postoperative recovery status.

Table 2

POSTANESTHESIA SCORE		ADMIT	15	30	1 HR	2 HRS	DISMISS
<u>ACTIVITY</u>	4 EXTREMITIES	2	2	2	2	2	2
ABLE TO MOVE VOLUNTARILY	2 EXTREMITIES	1	1	1	1	1	1
OR ON COMMAND	0 EXTREMITIES	0	0	0	0	0	0
<u>RESPIRATION</u>							
ABLE TO DEEP BREATHE ON COMMAND		2	2	2	2	2	2
DYSPNEA, SHALLOW OR LIMITED BREATHING		1	1	1	1	1	1
APNEIC		0	0	0	0	0	0
<u>CIRCULATION</u>							
BP ± 20MM OF PREANESTHESIA LEVEL		2	2	2	2	2	2
PRE-OP BP	BP ± 20-50MM OF PREANESTHESIA LEVEL	1	1	1	1	1	1
	BP ± 50MM OF PREANESTHESIA LEVEL	0	0	0	0	0	0
<u>CONSCIOUSNESS</u>							
AWARE OR RESPONDS TO QUESTIONS/COMMANDS		2	2	2	2	2	2
AROUSABLE ON CALLING		1	1	1	1	1	1
NOT RESPONDING		0	0	0	0	0	0
<u>COLOR: NORMAL</u>							
PALE, DUSKY, BLOTCHY, JAUNDICED, OTHER		2	2	2	2	2	2
CYANOTIC		1	1	1	1	1	1
		0	0	0	0	0	0
TOTAL							

Table 3

POST-OP SCORE	ADMIT	30 MIN.	1 HR	DISMISS
Able to walk with minimal assistance	2	2	2	2
Very unsteady, requires support to walk	1	1	1	1
Cannot stand or walk	0	0	0	0
Vital signs stable				
BP ± 20mm of preanesthesia	2	2	2	2
BP ± 20-50mm of preanesthesia	1	1	1	1
BP ± 50mm of preanesthesia	0	0	0	0
Dressing dry and intact	2	2	2	2
Minimal drainage, may have drain	1	1	1	1
Wound requires frequent dressing changes	0	0	0	0
Able to ingest fluids	2	2	2	2
Ingests fluids, but some nausea/vomiting	1	1	1	1
Protracted vomiting	0	0	0	0
Is able to void	2	2	2	2
(this criteria must be met)				
Cannot void	0	0	0	0
TOTAL				

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