Revista Mexicana de Anestesiología

CONFERENCIAS MAGISTRALES
Vol. 33. Supl. 1, Abril-Junio 2010
pp S265-S269

Combined regional-general anesthesia

Merlin D. Larson, M.D.*

* Professor UCSF, San Francisco.

INTRODUCTION

The following comments are based upon the author's interpretation of references that are cited, together with his experience of over 40 years in the administration of anesthetics. While they will undoubtedly seem fanciful and unrealistic to many practitioners, in the author's opinion it is possible in most cases to provide an ideal anesthetic inexpensively by using a combined regional-general anesthetic method. Our goal as anesthesiologists is to alleviate pain and the focus of this lecture is to emphasize techniques that achieve this purpose.

RATIONALE

If patients are asked what they most fear about surgery and anesthesia, their response is usually that they abhor the thought of pain, nausea, and vomiting[1]. Surprisingly, the fear of dying during surgery and awareness while paralyzed are of secondary importance to prospective patients. If we take these primary fears to heart, it then seems appropriate to tailor our anesthetic management toward outcomes that eliminate pain, nausea, and vomiting.

Some might say that a total intravenous anesthetic, a long-acting opioid at the end of the procedure, and an abundant supply of antiemetics can alleviate the problems that patients fear most. In reality, however, it is impossible to predict precisely the opioid dose prior to emergence in order to avoid pain, and furthermore, even with the combination of several antiemetic agents, patients still continue to vomit in the PACU.

Regional anesthesia, if properly performed, can usually allow the anesthetic to be delivered without the one class of drugs (opioids) that are the predominant cause of anesthetic-induced nausea and vomiting[2]. Although it is true that patients who have regional anesthetics can also vomit during the procedure, the addition of a light general anesthetic without the use of opioids tends to reduce the dual complications of pain upon emergence and nausea and vomiting.

Commonly patients will make the statement, «Just put me to sleep, doctor». While it is easy to sympathize with this desire, it requires the consciencious anesthesiologist to discuss the advantages of a regional anesthetic prior to the induction of anesthesia. We have to accept the fact that most patients do not like to be totally awake during their surgical procedures and this is true even with a total lack of surgical pain produced by an excellent regional anesthetic. Some sedation in the form of a continuous infusion of propofol or midazolam is then often used to keep the patient sedated during the procedure.

The sedated patient without an established airway can be a source of irritation to both the surgeon and the anesthesiologist. Airways can obstruct and patients can awaken at the most inconvenient times to complain of pain in their arms or an itch on their nose. During these arousals, there can be movement of the operative site and this is annoying to the surgeons. The author's preference therefore is to have patients totally asleep with a light general anesthetic. The airway then is controlled either with an LMA or endotracheal tube and the regional block is continued throughout the case, thus avoiding bothersome arousals that can disrupt the surgery. These comments therefore introduce the concept of the regional-general anesthetic.

CONTRAINDICATIONS

Clearly there are numerous cases on the surgical schedule that cannot be done with the combined regional-general anesthetic technique. Extensive spine surgery, open-heart surgery, many head and neck procedures, and surgery in the axilla involve operative procedures that are difficult to block with regional techniques. Even some of these procedures could be done with regional-general, but the effort and risks of doing so might outweigh the advantages. Lumbar lami-

nectomy can be done with epidural-general but many surgeons would prefer to avoid a regional anesthetic technique on patients with neurological deficits within the dermatomes covered by the regional block. The author's concept as presented here is not to insist on regional-general anesthesia for all procedures but simply to emphasize that many cases can be managed with this technique and that it offers many advantages for the patient and the surgeon. Although laparoscopic procedures are often performed with general anesthesia, for certain procedures such as laparoscopic colectomy, nephrectomy and hysterectomy, incisions are made that result in considerable pain in the PACU unless epidural or other regional techniques are used.

HISTORICAL DEVELOPMENT

The origins of combined regional-general anesthetic go back to the beginning of the 20th century. Several surgeons during that era had observed that the commonly used anesthetics such as ether, chloroform, and nitrous oxide did not adequately block the stress response to surgery. Even deep inhalation anesthesia with ether or chloroform was unable to block «sensation», although patients were totally unaware and immobile during their operative procedures. Harvey Cushing (1869-1939) published several short articles advocating the use of peripheral nerve blocks in combination with general anesthesia to prevent «shock» in the postoperative period. He promoted the use of anesthetic records to document the blood pressure and heart rate changes that occur during surgery. His early records confirm that ether was a very poor analgesic, although it allowed surgeons to do their work because the spinal effect of the anesthetics suppressed movement in response to even the most severe painful and traumatic procedures.

George W. Crile (1864-1943), Chief Surgeon at the Cleveland Clinic, developed this idea further. Crile wrote two books on the subject of stress free anesthesia, both entitled «Anoci-Association» Anesthesia[3]. In 1905, the less toxic local anesthetic procaine was introduced by Einhorn, and Crile used this drug to ablate the stresses of surgical manipulation. His method was to have a very light general anesthetic with nitrous oxide and oxygen administered by mask and then to anesthetize all tissues with dilute procaine prior to cutting or incising them with a knife.

Clearly, Crile's idea could only be used for relatively minor procedures because continued injections of procaine would eventually lead to local anesthetic toxicity. Nevertheless, the Crile technique was accepted as a valid idea but certainly not the real answer to extensive procedures within the abdomen or thorax. Although spinal anesthesia was used for upper abdominal procedures, Crile recognized that it was necessary to have patients asleep in order to reduce any remaining visceral nociception that was not blocked by the spinal anesthetic.

The real breakthrough in the combined regional-general anesthetic technique arrived with the publication in 1921 by Fidel Pages[4] about a new type of anesthetic that he named «metameric anesthesia». In his classic paper, he pointed out that spinal anesthesia anesthetized portions of the body (namely, the perineal area and lower extremities) that were not part of the surgical field. His idea was to place the local anesthetic into the epidural space along the nerve roots that supplied dermatomes that were anticipated to by stimulated by the surgical manipulations[5].

Unfortunately Pages died in an automobile accident before his ideas could be promoted and a hiatus of 10 years elapsed before A. E. Dogliotti independently described the epidural technique that we use today. The loss of resistance method of identifying the epidural space should actually be credited to Sicard, but nevertheless, Dogliotti applied it for the use of anesthesiologists insofar as it led to safe method for local anesthetic injections into the epidural space[6]. The Cuban anesthesiologist Curbello was the first to use a continuous epidural technique by threading a ureteral catheter through the epidural needle[7].

Meanwhile, the local anesthetic injections of peripheral nerves that started with Halsted in 1885 had progressed significantly in the first half of the 20th century. Nerve injections by the use of paresthesias were gradually replaced by nerve stimulation techniques and this significantly improved the success rate of these blocks. The last few years have seen the nerve stimulation technique slowly being replaced by ultrasound visualization of the nerves where one can actually see the anesthetic surround the nerve as it is being injected. Threading catheters after injection through the localizing needle has the potential for failure if the block is to be continued overnight. Although there are stimulating catheters that allow the anesthesiologist to position the tip of the catheter at the correct site, the success rate with these special catheters at this time do not have the same success as continuous epidural catheters.

TECHNIQUE

Epidural catheters should be placed correctly within the epidural space at the appropriate dermatome. For thoracic surgery, catheters should be T5-T6, for upper abdominal surgery at T7-T8, and for lower abdominal surgery at T9-T10. For perineal surgery, low lumbar catheters can provide adequate intraopeative anesthesia and postoperative pain control but lower extremity weakness prevents ambulation so these catheters are usually removed within 24 hours. Most knee and hip procedures today are performed with either femoral nerve blocks plus light general anesthesia or femo-

ral/sciatic/obturator nerve blocks and light general anesthesia. The advantage of peripheral nerve blocks is that enoxaparin can be given while the catheters are in place, and bladder catheters are not required. Lumbar epidural anesthesia is indicated for bilateral total knee replacements because this method more consistently provides pain relief for these extensive procedures.

Once the epidural is positioned correctly, the anesthesiologist must decide whether to administer local anesthetics during the operative procedure. Opinions on this issue vary widely, and each individual anesthesiologist seems to have a strong commitment to his or her own technique. Essentially, there are three basic approaches to the combined epidural-general anesthetic technique. One is to totally ignore the epidural catheter until the end of the procedure, at which time a loading dose of epidural anesthetic such as 0.25% bupivacaine or 0.5% ropivacaine is injected prior to emergence. The second approach is to use a very dilute local anesthetic, such as 0.125% bupivacaine with fentanyl 2 μg/cc, during the procedure and to administer additional intravenous opioids as needed to control blood pressure and heart rate. The third approach is to think of the anesthetic management essentially as a regional anesthetic. Potent local anesthetics such as 0.5% ropivacaine are used from the start of surgery and continued throughout the procedure. Opioids are generally not required because the neuraxial block provides antinociception. In this case, additional drugs such as propofol or low dose inhalation agents are used only to produce unconsciousness. Although the author prefers the latter approach, it usually does require the use of vasopressors such as dopamine or phenylephrine to counteract the hypotensive effects of the sympathectomy.

ADVANTAGES

It is now useful to review the evidence that thoracic epidural anesthesia can improve outcome. Two theoretical considerations have led many to believe that proper management of thoracic epidural anesthesia can lead to an improved surgical outcome during abdominal surgery, even when compared to general anesthesia with some of the newer anesthetic agents. The first theory is that pre-emptively blocking the pain pathways before the onset of surgical trauma will permit a smoother postoperative recovery with less pain and earlier ambulation(8). This concept appears to apply to small laboratory animals and may not be relevant to humans. The second theory is that preventing the hormonal responses to surgical trauma will lead to less catabolism, earlier mobilization, and faster return of bowel function(9). Surgical entry into the abdominal cavity is considered to be one of the most stressful of all surgical interventions. The hormonal response to this type of surgery during general anesthesia consists of elevated catecholamines, elevated ACTH and cortisol, and elevated ADH. These responses lead to negative nitrogen balance, inhibition of bowel function, and activation of clotting mechanisms(10). Properly managed thoracic epidural anesthesia can prevent most of these deleterious hormonal responses during surgery on the lower abdomen. Whether this control of stress hormones can actually lead to improved outcomes is still a controversial topic. Wu et al. recently reported a favorable effect of epidural techniques on outcome(11,12) and this confirms earlier studies that showed a dramatic reduction of morbidity in high risk surgical patients(13,14).

De Leon-Casasola has recently pointed out that many studies that compared the technique of epidural anesthesia to opioid supplemented anesthetics were flawed because the efficacy of the epidural was never tested. In other words, the catheters were inserted but whether they were in the right place or if adequate blocks were obtained was never known. Also in many cases the general anesthetic portion of the epidural-general anesthetic was not significantly modified to take advantage of the epidural(15). For example, if one administers large doses of systemic opioids during the epidural-general anesthetic, then it is not surprising that the return of bowel function and respiratory function are not significantly different from a routine general anesthetic. Ineffective doses of epidural agents would not be expected to have any beneficial effect on either pain scores or outcome, which was recently confirmed in a well-designed study(16).

While there have been numerous studies that have attempted to uncover economic benefits of combined regional-general anesthesia, it now seems apparent that epidural anesthesia is not a single entity that can be compared between different institutions. Some anesthesiologists continue to use lumbar catheters for thoracic surgery. Others place the epidural preoperatively and use it only in the postoperative period. Some place the catheters, either peripheral nerve catheters or epidurals, and never test whether they are placed correctly or actually produce any effect at all. After all, there is little harm in running a dilute concentration of local anesthetic into the subcutaneous space on into the vicinity of a nerve sheath. However, those studies that have confirmed the presence of an actual neuraxial or peripheral nerve block have consistently reported superior pain relief in the PACU and in the immediate postoperative period(17). These studies also show that opioid use is decreased with regional anesthesia, and theoretically, this has the benefit of reducing opioid related side effects.

COMPLICATIONS AND DISADVANTAGES

After discussing the advantages of the combined regional-general anesthetic technique, it is appropriate to discuss the

disadvantages. Peripheral nerve and neuraxial blocks have a very small incidence of nerve injury. The incidence is estimated to be approximately 1 in 50,000 blocks and most injuries resolve completely within 1 year. There is a delay of surgery for placing the block and sometimes the experience can be painful and tedious for the patient. Ideally, there should be extra personnel that can place the catheters in a separate block area where monitors and resuscitation equipment are available. This allows adequate sedation to be delivered for each patient and makes the technique acceptable to more subjects. The full dose of local anesthetic (for peripheral nerve blocks) can be given in this «block» area provided that there are equipment and drugs available for treatment of rare intravascular injections. Peripheral nerve blocks should not complicate the anesthetic management. Occasionally, there might be a rare case of a paravertebral block entering the epidural space and resulting in the production of bilateral epidural anesthesia. In this case, hypotension would become apparent secondary to the drug-induced sympathectomy. Neuraxial blocks are not established until the patient is in the operating room.

SUMMARY

What is the ideal anesthetic for stressful surgical procedures? Some of the important features are as follows: no delay of surgery, no discomfort for the patient during placement of lines, absence of awareness during the surgical procedure, pain-free emergence, absence of mental «cobwebs» in the recovery room, smooth transition to prolonged pain control, absence of nausea and vomiting, and early return to ambulation and gastrointestinalfunction. These objectives can best be achieved with the use of combined regional-general anesthesia. Although the combined technique has not been proven by all authors to decrease hospital stay, at least it does not increase postoperative complications or increase hospital stay. Of course each anesthetic must be tailored for one individual patient but are we missing the point by concentrating *only* on decreased hospital costs and earlier discharge? Our goal as anesthesiologist is to *decrease* the amount of *pain* experienced by the patient. Regional anesthesia can decrease the amount of pain these patients experience as they emerge from surgery and in the immediate postoperative period. Properly managed, the only pain experienced by the patient, for what would otherwise usually be a very painful operation, should be during the placement of the initial intravenous line.

Finally, it is important to summarize the reasons why regional-general anesthetic techniques are not more widely used. The most important barrier toward successful management of anesthetics such as those described in this presentation is the skill of the anesthesiologist. In order to place these neuraxial and peripheral nerve blocks correctly and in a timely manner without hurting the patient, the anesthetist has to first learn to master the manual skills. Thoracic epidural anesthesia is not a procedure that can be learned by the maxim: watch one, do one, teach one. The same applies to peripheral nerve blocks. This is where a strong educational program is necessary and this cannot be done without the support of the surgeons, the entire anesthesia department, and the nursing units. It is not safe, for example, to send a patient onto a regular ward in any hospital with an epidural catheter unless the nurses understand the side effects and complications that can occur with these blocks. Although rare, epidural hematomas can occur and require surgical evacuation within 8 hours of the onset of symptoms.

REFERENCES

1. Orkin FK. Patient preferences for immediate postoperative recovery. Br J Anaesth 2003;90:526-7.
2. Apfel CC, Kranke P, Piper S, Rusch D, Kerger H, Steinfath M, Stocklein K, Spahn DR, Mollhoff T, Danner K, Biedler A, Hohenhaus M, Zwissler B, Danzeisen O, Gerber H, Kretz FJ. [Nausea and vomiting in the postoperative phase. Expert- and evidence-based recommendations for prophylaxis and therapy]. Anaesthesist 2007;56:1170-80.
3. Crile G, Lower W: Anoci-Association. Philadelphia, WB Saunders Company, 1914
4. Pages F. Anestesia metamérica. Rivista de la Sanidad Militar 1921;11:351-365.
5. de Lange JJ, Cuesta MA, Cuesta de Pedro A. Fidel Pages Mirave (1886-1923). The pioneer of lumbar epidural anaesthesia. Anaesthesia 1994;49:429-31.
6. Dogliotti A. Anesthesia. Chicago, SB Debour, 1939.
7. Curbelo M. Continuous peridural segmental anesthesia by means of a ureteral catheter. Anesth Analg 1949;28.
8. Katz J, McCartney CJ. Current status of preemptive analgesia. Curr Opin Anaesthesiol 2002;15:435-41.
9. Carli F, Mayo N, Klubien K, Schricker T, Trudel J, Belliveau P. Epidural analgesia enhances functional exercise capacity and health-related quality of life after colonic surgery: results of a randomized trial. Anesthesiology 2002;97:540-9.
10. Wilmore DW. From Cuthbertson to fast-track surgery: 70 years of progress in reducing stress in surgical patients. Ann Surg 2002;236:643-8.
11. Wu CL, Hurley RW, Anderson GF, Herbert R, Rowlingson AJ, Fleisher LA. Effect of postoperative epidural analgesia on morbidity and mortality following surgery in medicare patients. Reg Anesth Pain Med 2004;29:525-33;discussion 515-9.
12. Wu CL, Sapirstein A, Herbert R, Rowlingson AJ, Michaels RK, Petrovic MA, Fleisher LA. Effect of postoperative epidural analgesia on morbidity and mortality after lung resection in Medicare patients. J Clin Anesth 2006;18:515-20.

13. Yeager MP, Glass DD, Neff RK, Brinck-Johnsen T. Epidural anesthesia and analgesia in high-risk surgical patients. Anesthesiology 1987;66:729-36.
14. Rodgers A, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, Sage D, Futter M, Saville G, Clark T, MacMahon S. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomized trials. BMJ 2000;321:1493.
15. de Leon-Casasola OA, Lema MJ. Postoperative epidural opioid analgesia: what are the choices? Anesth Analg 1996;83:867-75.
16. Norris EJ, Beattie C, Perler BA, Martinez EA, Meinert CL, Anderson GF, Grass JA, Sakima NT, Gorman R, Achuff SC, Martin BK, Minken SL, Williams GM, Traystman RJ. Double-masked randomized trial comparing alternate combinations of intraoperative anesthesia and postoperative analgesia in abdominal aortic surgery. Anesthesiology 2001;95:1054-67.
17. Liu SS, Wu CL. The effect of analgesic technique on postoperative patient-reported outcomes including analgesia: a systematic review. Anesth Analg 2007;105:789-808.