

JOHAN RAEDER,Dept of Anaesth, OmniaSykehuset, University of Oslo
Oslo, Norway

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The choice of anaesthetic for ambulatory surgery should be based on considerations of safety, quality and cost-efficacy.

In the survey by Warner and colleagues from the early 90s, the mortality of > 45 000 ambulatory surgery cases was similar to matched control persons not undergoing surgery¹. Presently, as much as 60-70% of all elective procedures in the are performed on an ambulatory basis. Therefore, a trend towards more extensive procedures in higher risk and elderly patients being treated in the ambulatory setting, is emerging. Despite this, in a recent survey of 18,500 Danish patients, there was no mortality caused by the anaesthetic procedure and no cases of permanent disability (Engbaek J, personal communication). The choice of anaesthetic technique should be based on demands for zero risk of mortality and permanent disability, with an emphasis on quality and cost-efficacy.

The most important aspects of quality are rapid and clear-headed emergence, minor or no post-operative pain, absence of post-operative nausea or vomiting and absence of any side-effect or discomfort related to the anaesthetic technique.

Cost-efficacy conclusions are highly dependant upon local issues: What are the drug and equipment acquisition costs? What are the costs of staffing? How is the unit built and organized? Further, a total economic setting should always be considered; for instance: Will savings in drug costs create more costs for staffing or patient surveillance? More costs for rescue drugs or extra measures? Especially important are extra costs related to choice of anaesthetic and prolonged stay in the recovery unit, unanticipated hospital admission or re-admission after hospital discharge.

Finally, the success of a chosen anaesthetic is highly dependant upon adjuvant issues, such as skill and routines of the personnel involved, proper monitoring and dosing, and use of non-anaesthetic adjuvant drugs and techniques for avoiding pain and nausea.

REGIONAL TECHNIQUES^{2;3}:

Regional techniques offer minor systemic drug effects, option of being awake during the procedure and superior pain control immediately after the procedure². However, the ideal of zero mortality and no permanent disability after ambulatory care¹ has been challenged by reports of rare, but serious complications of permanent nerve damage⁴, spinal haematomas and spinal toxicity⁵. In a report from France, 56 major complications were reported after regional anaesthesia in a mixed population of 158,000 in- and out-patients⁶. These included 9 cardiac arrest cases during spinal anaesthesia and 12 cases of permanent nerve damage after peripheral nerve blocks. However, most of these complications occurred in sick in-patients.

Regional anaesthesia has helped develop the concept of fast-tracking, i.e. direct transfer of the patient from the operating room to a step down recovery ward, bypassing the post-anaesthesia care unit (PACU)⁷. In a recent US survey of 5 centres, 90% of all cases with monitored anaesthesia care (MAC; i.e. local anaesthesia with IV sedation) were fast-tracked compared to 32% of cases with general anaesthesia⁸. However, the time consumption required for regional block establishment and delayed recovery due to urinary retention or weak legs after spinal anaesthesia, are still major challenges². In a recent British survey of practice in 270 departments for either day-case cystoscopy or knee-arthroscopy, all the respondents used general anaesthesia as their major method, although supplementary local anaesthesia was used by 26% for cystoscopy and 77% for knee-arthroscopy⁹.

Better post-operative pain control is still a major area requiring improvement¹⁰, and regional techniques have consistently proved beneficial^{10;11}. As regional analgesia usually is established before initiation of the surgical trauma, there is potential to exploit the benefits of pre-emptive analgesia with less pain-generating reflexes into the central nervous system. However, in a survey of clinical use of pre-emptive analgesia, prolonged peri-operative epidural analgesia was the only modality associated with a possible pre-emptive effect¹². The disappointing results of pre-emptive analgesia in most clinical studies may be due to shortcomings in study design. Some recent studies have suggested a reliable pre-emptive analgesic effect when an efficient drug¹³ or local anaesthetic block is applied in advance of surgery and continued per- and post-operatively.

Because less opioid analgesics are needed when regional techniques are used, a lower incidence of postoperative nausea and vomiting is usually seen compared with general anaesthesia¹⁴. The choice of technique may have an impact on the incidence of impaired cognitive post-operative function, which is reported to have a higher frequency in elderly patients and after major surgery¹⁵. When regional anaesthesia was compared with general anaesthesia in a prospective, randomized way; there was a tendency (P=0.06) of less impairment after regional techniques¹⁶. However, neither of these studies differentiated clearly between the effect of surgery and the effect of anaesthesia.

Local anaesthesia combined with sedation, also called monitored anaesthesia care (MAC), is a concept of increasing popularity. The technique is simple and cheap; and is associated with a high potential of fast-tracking¹⁷. However, care should be taken to avoid overdosing of local anaesthetics (e.g. during liposuction) and the respiratory depressant adjunctive sedatives.

Sedation during regional techniques may be indicated either because of pain, patient anxiety or patients' preference. However, use of sedation may add some new side-effects. In a study of regional patients with either propofol or remifentanyl sedation, Servin and colleagues showed more respiratory depression and per-operative nausea with remifentanyl, and more per-operative pain and delayed emergence with propofol¹⁸.

Regional anaesthetic drugs are usually cheaper than their general anaesthetic counterparts. However, increased time-consumption for block-establishment and prolonged bed rest or urinary retention after spinal blocks, should be added to the drug cost calculation, weighted against uneventful recovery with less nausea and pain. Depending on the local circumstances, the net economic balance may be totally different in different settings. In a study of desflurane versus spinal anaesthesia for hysteroscopy, the latter was cheaper¹⁹, whereas others found no difference in total cost when spinal anaesthesia was compared with general anaesthesia for hysteroscopies²⁰. However, in studies of successfully applied monitored anaesthesia care with local anaesthesia and sedation, usually there are significant savings²¹.

GENERAL ANAESTHESIA:

General anaesthesia with modern agents has a record of very good safety, rapid onset, rapid offset, rapid emergence and ease of administration. However, when choosing a general technique, the choice of inhalational, intravenous or a combination of these techniques is important²².

Inhalational anaesthesia:

Even though the pungency of sevoflurane is low and its action rapid, it does not seem to be very popular in adults or children, due to ease of IV-line establishment with the EMLA cream and some incidence of emergence agitation after sevoflurane²³. There is also an issue of increased incidence of shivering²⁴ and PONV after inhalational agents, the latter especially with isoflurane or desflurane²⁵, when compared with propofol. However, inhalational agents provide better patient-maintained respiration and more rapid immediate emergence when compared to propofol²⁶. This difference in emergence is only evident during the first 5-15 minutes after short procedures, and is presently being challenged by techniques of remifentanyl+Propofol combined. For procedures lasting more than 2-3 hours there seems to be a benefit with desflurane²⁷ in terms of faster emergence and better respiration when compared with sevoflurane.

Although controversial, nitrous oxide continues to be popular with many ambulatory clinicians, due to rapid offset, absence of respiratory depression and combined analgesic+hypnotic action, reducing the need of other anaesthetics²⁸. One problem with nitrous oxide is the cumbersome and expensive equipment needed for safe administration and scavenging; adding to investment costs which should be balanced against the fairly low costs for use in the individual case.

Intravenous anaesthesia:

Propofol is, by many, considered to be the cornerstone in modern ambulatory general anaesthesia, due to a rapid and clear-headed recovery often in a pleasant mood, combined with some protection towards nausea and vomiting. In order to dose more precisely, the commercial target control infusion (TCI) system has become popular in Europe. However, the algorithm in Diprifusor® is not very accurate²⁹, the pre-filled syringe system is expensive and it has recently been shown that a good clinician may improve total economy by manual infusion schemes of generic propofol³⁰. However, the economy issue may change as new and better pump algorithms are launched for generic propofol. Another promising development is to target the propofol computer pump for *effect site* concentration instead of serum concentration³¹, allowing for more accurate and fast titration to desired level of effect.

The latest addition to the opioid armamentarium, remifentanyl, is very well suited for ambulatory care due to rapid onset, similar to alfentanil; and an unrivalled rapid clearance within minutes, even after large doses or prolonged administration. However, questions have been raised if these potent opioids may induce acute tolerance and increased post-operative need of analgesics after a few hours of infusion or repeated administration³²⁻³⁴.

Neuromuscular block:

The use of neuromuscular blocking agents has definitely declined in modern ambulatory surgery. Almost all cases of ambulatory surgery have an empty stomach and the surgical case mix is mostly procedures not needing profound muscle relaxation. Further, there is decreased use of endotracheal intubation due to increased popularity of the laryngeal mask airway (LMA)³⁵. Still, there are cases where a 100% guarantee of immobility during surgery is needed (e.g. eye-surgery, ear surgery, micro-surgery) and others where many anaesthesiologists prefer to have an endotracheal tube in place for safety reasons (e.g. tonsillectomy, laparoscopy).

ADJUVANT DRUGS:

Because modern general anaesthetic drugs are cleared very rapidly, adequate pain control after emergence is vital. Premedication with paracetamol and COX-II selective NSAIDs should be considered, alternatively these drugs or a conventional NSAID may be given IV. Local anaesthesia in the wound area is another measure to decrease the intensity of post-operative pain. Corticosteroids are shown to have both analgesic and antiemetic properties³⁶, and may be a valid alternative. For high risk cases further antiemetic prophylaxis should be considered, such as 5HT3 antagonists³⁷. Both for pain and nausea prophylaxis, a multimodal approach with different additive or synergistic drugs is most efficient.

HOW TO MAKE A FINAL CHOICE OF TECHNIQUE IN THE INDIVIDUAL CASE?

There is no conclusive evidence as to highlight any technique as superior in safety. The decision must be made on quality for the patient and cost-efficiency for the unit. Quality for the patient may vary individually, depending upon personal preferences, such as being awake, fear of needles, risk and tolerance of side-effects such as postoperative nausea and pain. Cost-efficiency will also vary individually with the unit in question. Acquisition costs of drugs, staffing, out of theatre induction or regional block facilities, post-operative recovery facilities may influence cost.

In summary,

- 1) For superficial surgery or cases with minor surgical invasiveness, local anaesthesia with minimal sedation may be preferred.
- 2) For surgery of long duration, in areas suitable for regional anaesthesia, with high intensity of post-operative pain, a regional nerve-block may be recommended. The same may be valid in patients with a definite preference for regional techniques or in patients with a high risk of nausea or vomiting.
- 3) For other procedures general anaesthesia is usually chosen, mostly due to decreased time and ease of administration. However, with general anaesthesia care must be taken to ensure optimal prophylaxis against pain and nausea in the postoperative period.

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