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Current issues in ambulatory anaesthesia[1]

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1. Introduction

Current Issues in Ambulatory Anaesthesia was the theme of a Breakfast Panel during the 54th Annual Meeting of the Canadian Society of Anaesthetists in Vancouver, BC, Canada, 6–10 June, 1997. Frances F. Chung, from Toronto, Canada moderated the session and Sujit K. Pandit, from Ann Arbor, MI, made the presentation. A large audience enthusiastically joined in the discussion.

2. Preoperative fasting

Three editorials published in the 90s in three different international journals, one each from Canada, USA, and the UK [1–3], recommended a change in our traditional guidelines for preoperative fasting time. Why are we suddenly challenging the time honored tradition of NPO (nothing by mouth) after midnight?, and why did we have the traditional policy of NPO after midnight in the first place?

Much has to do with a paper by Mendelson published in 1946 [4]. It was a very enlightening paper but was also very disturbing. It told us that the incidence of death after general anaesthesia due to pulmonary acid aspiration in obstetrics is very high, 1:700. At about that time, we made two assumptions: (1) if a patient does not consume any food or drink 6–8 h before surgery, then the stomach will remain empty and thus, there will be no or minimum risk of pulmonary aspiration; and (2) if the patient consumes any food or drink 6–8 h before surgery, then it will remain in the stomach for many hours increasing the chance of acid aspiration. As we now know, neither of these two assumptions is entirely correct. Nevertheless, with those assumptions, the tradition of NPO after midnight for both solid food and drinks was firmly established.

In doing so, surgeons and anaesthesiologists conveniently ignored the work by Beaumont published 150 years ago [5]. He showed that solids and liquids behave quite differently after ingestion. While solids take 6–8 h to clear from the stomach, liquids pass into the duodenum quite fast, in 2 h or less. This fact was confirmed by other investigators using sophisticated and modern techniques of study [6].

Then came the surge for outpatient surgery in the 1970s and the 1980s. With its increasing popularity, and changed logistics, some brave anaesthesiologists, mostly from Canada, UK, and Australia, and of course patients themselves started to ask this important question: 'is a 5-h fast before surgery really justified'? [7]. We recognized that long fasting is not merely an inconvenience to the patient, it is stressful, and it may have physiological consequences. Long fasting causes hunger, thirst, headache, noncompliance, and in children may cause dehydration and hypoglycemia [8,9].

In the 80s, a large number of research on this topic were published. Many studies showed that ingestion of clear liquids before elective operations may in fact reduce the residual gastric volume and may even increase the gastric pH [10–13]. This is because of the dilutional effect of the clear liquid on the stomach acid and the stimulation of peristaltic activities by ingestion.

The serious question of pulmonary aspiration must also be considered. How common is pulmonary aspiration during elective surgery today? In 1946, Mendelson reported a high death rate of 1:700 due to pulmonary acid aspiration during general anaesthesia in obstetrics [4]. How has that changed, especially for outpatient surgery? Olsson et al. [14] from Sweden did a large

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retrospective study of 185 000 cases published in 1986, they concluded that the aspiration rate in all comers, elective and emergency surgery, was 4.3:10 000, with a death rate of 1:35 000. A vast majority of the aspirations took place during emergency operations and in young children, especially at night. Nevertheless, this was a significantly better result than what Mendelson had reported earlier.

The Federated Ambulatory Surgery Association (FASA) after a prospective study of 87 000 cases, reported [15] that the incidence of aspiration during ambulatory surgery was 0.3:10 000. More recently Warner from Mayo Clinic has reported [16] an incidence of aspiration, 1:9000 in ASA 1 and 2 patients with no death.

What is the reason for this tremendous improvement in the incidence of pulmonary aspiration since the days of Mendelson? Undoubtedly, this is because of better identification of patients who are at risk of aspiration, namely: emergency surgery, pregnancy, obesity, etc.; use of appropriate prophylactic measures in 'at risk' patients; and especially, wide-spread use of rapid sequence induction and cricoid pressure with endotracheal intubation in these patients. Although Mendelson did not mention one way or the other, it is very likely that none of the 44 000 patients that he studied had an endotracheal tube placed during general anaesthesia.

Recognition that clear liquids behave differently in the stomach than solids, and that the risk of pulmonary aspiration during elective surgery in healthy patients with physical status ASA 1 or 2 is extremely rare, are reasons for the three editorial pleas in the early 1990s to allow clear liquids before elective operations. Have we actually changed our practice regarding the traditional NPO guidelines? A group of investigators from the University of Michigan Medical Center addressed this issue with a national survey [17]. The results of that survey showed that by 1993, 70% of the anaesthesiologists in the USA have changed their practice and liberalized fasting guidelines in children while about 40% of them did it for adults.

3. Current guidelines for preoperative fasting

At the University of Michigan, the current recommendations for preoperative fasting in elective surgery are: in adults and children above three months of age, no solid food on the day of surgery, water in unlimited amounts up to 3 h before induction of anaesthesia. Infants who are more than three months, in addition, may take breast milk or infant formula up to 4 h before induction of anaesthesia. Infants three months or younger may have clear liquids (sugar water) up to 2 h before induction of anaesthesia, and breast milk up to 3 h before induction. In children they have liberalized the definition of clear liquid to include clear fruit juice (e.g. apple juice) [18].

The American Society of Anesthesiologists (ASA) has recently appointed a task force, with Mark Warner, as its Chair to develop its own guidelines for preoperative fasting. The Committees report is not published yet, but it is expected that the Committee will suggest a simple guideline that will be same for all ages: clear liquids up to 2 h before induction of anaesthesia, breast milk up to 4 h, and solids up to 8 h before induction of anaesthesia.

A lively discussion followed Dr Pandit's presentation. The majority of the audience agreed with the ASA's expected recommendations. However, others suggested 3 h fasting for clear liquids may be more realistic.

4. Postoperative fasting

Schreiner et al. from Philadelphia published, in 1992 which asked this question: should children drink before discharge [19]? Ability to drink, or oral intake has been a prerequisite for discharge after outpatient surgery. Is it a good practice? Schreiner studied a large number of children undergoing outpatient surgery. One group, called mandatory drinkers, had to have a drink before discharge. The other group was offered a drink only if they asked for one, this group was called elective drinkers. There was a higher incidence of vomiting in the Post Anaesthesia Care Unit (PACU) and increased PACU time in the mandatory drinker group compared to the elective drinkers. There was no difference in vomiting after discharge. The authors recommended that children should not be required to drink before discharge.

On the basis of this paper, many anaesthesiologists have changed their discharge criteria and do not require the patients to show the ability to drink before discharge. Chung, who devised the well accepted PADSS discharge criteria, has in her latest version omitted this criteria for discharge [20].

The audience in general, agreed that the ability to drink should not be a part of discharge criteria, although the state of hydration should be carefully evaluated before discharge.

5. Is postoperative nausea and vomiting (PONV) still a problem?

When Gold published her paper in 1989 [21], it immediately became a classic. She reported an incidence of unanticipated admission after outpatient surgery of 2% which became a gold standard for ambulatory surgery practice at the time. The incidence is much lower now, close to 0.2–0.5% level. Her second

observation was that the most important anaesthesia related cause for unexpected hospital admission was nausea and vomiting.

A year earlier Patel and Hannallah had also showed that PONV was the most important anaesthesia related complication after outpatient surgery in children [22].

Is this still true today? Green from Scandinavia published a report in 1993 confirming many earlier published papers that nausea and vomiting are the most important reasons for delayed discharge after outpatient surgery [23]. This year, 1997, Splinter et al., presented the results of their study which showed an incidence of unanticipated admission of 1.1%, with PONV as the reason for admission in 18% of them [24]. Further, Carroll showed us that PONV after discharge is more common than PONV in the PACU [25].

Therefore, it seems that PONV is still a problem, but as we learn to identify the patients who are at higher risk for PONV [26], we may be able to take steps to remedy the situation. Who is at risk?

Table 1 lists the conditions that put patients at risk for PONV. Though it is not usually mentioned, the person who actually administers the anaesthetic and where the surgery is performed make a big difference in PONV. Cohen, an epidemiologist from Toronto, did a multicenter study on PONV at various hospitals in Canada [27]. She reported a huge difference in the incidence of nausea and vomiting among the hospitals, a range from 39 to 75%. Some anaesthesiologists are better than others in preventing PONV; they must be doing something right. The audience agreed that PONV is still a problem after outpatient surgery.

6. Is propofol an antiemetic?

Innumerable studies have shown that propofol anaesthesia is associated with less PONV than enflurane, isoflurane, halothane, desflurane or sevoflurane anaesthesia [28,29]. In a very instructive study, Hannallah compared halothane anaesthesia against propofol induction followed by halothane, and propofol induction followed by propofol infusion anaesthesia for strabismus surgery. The incidence of PONV after halothane was 58%, propofol–halothane 22%, but with propofol–propofol only 11% [30], a remarkable result. Even with ondansetron prophylaxis desflurane causes more PONV than propofol [31]. Thus, propofol anaesthesia is clearly associated with less PONV.

Is propofol an antiemetic for treatment of PONV? Borgeat from Switzerland suggested that it is [32]. She injected 10 mg propofol or equal volume of intralipid in the PACU for postoperative nausea, success rate after propofol was 81 vs. 31%. However, the effect was short lived. Ostman confirmed that the antiemetic effect of propofol is not due to intralipid solvent [33]. However, when Scuderi gave a small dose of propofol by infusion in the PACU, he found no antiemetic effect of either propofol or intralipid [34].

Apparently contradictory results on the efficacy of propofol as an antiemetic were obtained by a group of investigators from Dallas, Texas. At the last International Anesthesia Research Society (IARS) meeting, this group presented a study in which they either gave propofol 0.5 mg/kg or droperidol 0.625 mg at the end of a tubal ligation operation and both treatments were better than placebo in preventing PONV [35]. However, the same group presented another paper at the Society for Ambulatory Anesthesia (SAMBA) Annual Meeting this year, with exactly the same protocol for laparoscopic cholecystectomy but this time they reported propofol was equal to placebo [36]. Zestos also found propofol 0.2 mg/kg ineffective to treat vomiting in PACU [37].

A case report of intractable nausea and vomiting after cancer chemotherapy gives an interesting insight to the problem [38]. When all usual antiemetics, including ondansetron, droperidol and metoclopramide failed, the authors started a propofol infusion and measured propofol blood levels continually. Nausea and vomiting disappeared when blood level of propofol reached 197 ng/ml.

The same group (Gan et al.) recently published a comprehensive study on propofol and its antiemetic properties [39]. Their conclusions were: propofol used to induce and maintain anaesthesia is more effective than ondansetron (with thiopental–isoflurane anaesthesia) in preventing postoperative vomiting, and propofol anaesthesia is associated with fewer requests for rescue antiemetic and sedation in the early phase of recovery. Propofol anaesthetic for maintenance is equally effective as ondansetron 4 mg in preventing nausea in the first 6 h after the operation. Furthermore, propofol used only as the induction agent, or when given both for induction as well as at the end of surgery, 50–150 μg/kg per min for 30 min, is not as protective against

Table 1
Factors that increase the risk for PONV

Patient:
Female young, obese, preovulatory stage of menstrual cycle, history of PONV, motion sickness, pregnancy
Operation:
Eye, ENT, suction D&C, laparoscopy, orchidopexy
Anaesthetic/analgesics:
Opiates, nitrous oxide, volatile anaesthetic agents, muscle relaxant antagonist
Longer operation:
Hospital/anaesthesiologist:

postoperative nausea and vomiting The majority in the audience said they use propofol anaesthesia to reduce the incidence of PONV.

7. Nitrous oxide and PONV

Fisher in a recent editorial asked this question: does nitrous oxide cause vomiting [40]? There is no question that it does. When Hornbein gave nitrous oxide and oxygen anaesthesia to seven volunteers for an unrelated study [41], each of the subjects were nauseated after the anaesthetic. Therefore, nitrous oxide like all other inhaled anaesthetics, e.g. ether, cyclopropane, halothane, isoflurane, desflurane, sevoflurane does cause nausea to a greater or lesser extent. The real question is, does it increase the nausea and vomiting caused by other anaesthetics?

Alexander was the first to report (abstract) that nitrous oxide increases PONV, especially when fentanyl is added to the anaesthetic [42]. However, many other papers followed with conflicting results. For example Hovorka and Korttila claimed nitrous oxide does not increase PONV [43], a paper from the University of Michigan also supported that conclusion in children [44]. Most of the papers showed a slight but statistically insignificant increase in PONV after nitrous oxide anaesthesia.

As one would expect, recently we have started to get several papers describing meta analysis on this topic [45–47]. As we know, in meta analysis you pool all the available published papers, do some statistical manipulations and figure out if there is a statistical significance. All papers doing meta analysis on this topic agreed: nitrous oxide does increase PONV. To quote Hurtung [45], the question probably is not whether nitrous oxide causes vomiting, but when, why, in whom, and under what circumstances does nitrous oxide cause vomiting? Answers to these questions are not clear yet.

However, before we rush to remove nitrous oxide from our machine we need to consider a couple of points. The results of meta analysis must be considered carefully [40]. Typically meta analysis rarely have access to the original data because it depends on published summaries. Thus, flaws in the methodology of original studies can not be taken into account. Secondly, there may be publication bias, negative results are less likely to be published.

In addition, the well known beneficial effects of adding nitrous oxide to other anaesthetic agents often greatly outweighs any slight increase in PONV by nitrous oxide. Nitrous oxide decreases the requirement of other anaesthetic agents and narcotics which may translate into quicker recovery and reduced cost of expensive anaesthetic agents and narcotics. Inclusion of nitrous oxide may also reduce the incidence of awareness during general anaesthesia [48,49].

During the discussion, a majority in the audience said they use nitrous oxide when ever it is indicated, however, a few said they do not use nitrous oxide.

8. Reversal agents, intravenous fluids and PONV

Do the neuromuscular blocker antagonists, like neostigmine increase the incidence of PONV? This was first suggested by King [50].

There are three other papers, all from Dallas, TX, and the results are conflicting. The first one, published in 1994, claimed neostigmine does increase PONV [51]. The next paper published in 1995, claimed the same result in children [52]. However, a more recent paper from the same group published in 1996 [53] gives a different result. There was no difference in the rate of PONV whether or not the patient had received a reversal agent. Therefore, it seems that this question is still not settled. During discussion, the majority in the audience opined that they do not believe that reversal agents increase PONV.

Can we reduce the incidence of PONV by giving large amounts of preoperative intravenous fluids? Yogendran and Chung think so [54]. The group of patients that received 20 ml/kg i.v. fluid preoperatively before outpatient surgery, had less nausea and vomiting and over all less postoperative complications. Unfortunately, this is the only paper on this topic, this result needs confirmation.

There was a good discussion about the use of large quantities of intravenous fluids during outpatient operations, but no consensus developed.

9. Prophylactic antiemetics: droperidol versus ondansetron

As it appears, PONV is still a problem, but we can now identify the at-risk patients better. We know something about what drugs increase and which ones decrease PONV. However, there are occasions when a prophylactic antiemetic is the best way to deal with the situation. If we decide to use a prophylactic antiemetic, which agent should we use? Anaesthesiologists use many different agents for this purpose. To keep the discussion manageable, only droperidol and ondansetron were discussed.

Fortney et al. conducted a large prospective placebo controlled study comparing ondansetron 4 mg with droperidol 0.625 and 1.25 mg as prophylactic antiemetics given intravenously at the time of induction of anaesthesia in patients who are at high risk for PONV [55]. More than 2000 cases were enrolled. The results show that ondansetron 4 mg is superior to placebo, equal to droperidol 0.625 mg, and inferior to droperi-

dol 1.25 mg for antiemetic prophylaxis. The other important result was that there were no significant difference in the postoperative side effects among the three groups. There was no increase in dysphoria, agitation, or sedation after droperidol 0.625 or 1.25 mg. In a study with a very similar protocol, Tong et al., came out with virtually the same results [56]. Their results show that the incidence of vomiting following placebo is 65%, droperidol 0.625 mg is 37%, droperidol 1.25 mg is 20%, and ondansetron 4 mg is 30%.

What are the appropriate doses of droperidol and ondansetron for prophylaxis against PONV? The two papers quoted earlier [55,56] showed a dose response for droperidol, a dose of 1.25 mg was better than 0.625 mg. This confirmed the results of an earlier study by Pandit et al. [57] who showed that although a dose of 10 μg/kg ($\sim$6.25 mg for an average adult) was better than placebo or metoclopramide, droperidol 20 μg/kg ($\sim$1.25 mg for an adult) was superior. Watcha has shown that the optimal dose of ondansetron in paediatric patients is 50 μg/kg [58].

Since droperidol and ondansetron work in two different pathways, some people like to use a combination of the two for better results. It would appear that a combination might actually work better than either one [59,60].

What is the best time to give the prophylactic antiemetic? It does make a difference. Sun et al. showed that ondansetron is more effective when given at the end of the operation [61]. We know from analysis of previous studies [57] that droperidol is best given at the time of induction of anaesthesia. When given a short time before the end of operation or for very short operations, droperidol is not as effective [62]. For best results, droperidol should be given at least 30–45 min before the patient reaches the recovery room.

In today's cost-conscious environment, cost-effectiveness of any medication has become an important consideration. Watcha and Smith analyzed the cost-effectiveness of droperidol and ondansetron [63] and concluded that prophylactic antiemetic therapy is cost-effective for operations with a high frequency of emesis, whereas treatment of symptoms is more cost-effective when frequency was lower. For ondansetron, prophylactic use is cost-effective when the frequency of emesis exceed 33%, whereas prophylactic droperidol is cost-effective even if the frequency is 10%.

In a more elaborate and meticulous study, the same group of investigators have worked out a cost-effectiveness comparison of droperidol and ondansetron [56]. They looked at all aspects of cost, both direct and indirect. Their results show: droperidol 0.625 mg is the most cost-effective antiemetic. Weighted cost of antiemetics were as follows: Placebo, $8.65; droperidol 0.625 mg, $3.37; droperidol 1.25 mg, $5.17; and ondansetron 4 mg, $17.97.

10. Spinal anaesthesia for outpatient surgery

With the recent introduction of non-cutting pencil point spinal needles (Whitacre, Sprotte) postdural puncture headache has become a rarity even in young patients. Spinal anaesthesia has become a very acceptable form of anaesthesia for patients undergoing ambulatory surgery. However, controversy exists about the choice of local anaesthetic agent. The controversy has been heightened with publication of several papers implicating hyperbaric 5% lidocaine for causing transient neurological toxicity (cauda equina syndrome) and severe pain (transient radicular irritation) after single subarachnoid injection of hyperbaric 5% lidocaine with 7.5% dextrose [64–66]. Neither the hyperosmolarity of 7.5% dextrose nor the higher concentration of lidocaine could be implicated for the problem [67,68]. However, bupivacaine seems to be devoid of these side effects [69,70]. Vagadia has recently demonstrated that fentanyl 25 μg or sufentanil 10 μg when added to a small dose of hypobaric lidocaine, gives adequate and safe spinal anaesthesia with rapid recovery [71,72]. A more recent paper from the University of Michigan demonstrated that intrathecal sufentanil 20 μg in saline provides good analgesia for extracorporeal shock wave lithotripsy (ESWL) and allows early discharge [73]. Ben-David demonstrated efficacy and safety of saline dilution of bupivacaine with dextrose for ambulatory anaesthesia [74].

It was clear from the discussion that the vast majority in the audience uses spinal anaesthesia regularly for outpatient surgery using either lidocaine or bupivacaine with or without fentanyl.

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