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Relative value to surgical patients and anesthesia providers of selected anesthesia related outcomes

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Abstract

Background: Anesthesia side effects are almost inevitable in most situations. In order to optimize the anesthetic experience from the patient's viewpoint, it makes intuitive sense to attempt to avoid the side effects that the patient fears the most.

Methods: We obtained rankings and quantitative estimates of the relative importance of nine experiences that commonly occur after anesthesia and surgery from 109 patients prior to their surgery and from 30 anesthesiologists.

Results: Pain was the most important thing to avoid, and subjects allocated a median of $25 of an imaginary $100 to avoiding it. Next came vomiting ($20), nausea ($10), urinary retention ($5), myalgia ($2) and pruritus ($2). Avoiding blood transfusion, an awake anesthetic technique or postoperative somnolence was not given value by the group as a whole. Anesthesiologists valued perioperative experiences in the same way as patients.

Conclusions: Our results are comparable with those of previous studies in the area, and suggest that patients can prioritize the perioperative experiences they wish to avoid during their perioperative care. Such data, if obtained in the appropriate fashion, would enable anesthetic techniques to be compared using decision analysis.

Background

Surgery and anesthesia result in the development of pain, nausea and other adverse effects. Historically, physicians have applied their own judgments in determining which of these experiences are most important to avoid and have designed anesthetic and surgical techniques accordingly. However, in order to provide the most satisfactory outcome to the person actually experiencing the process, it makes intuitive sense to try to understand which adverse outcomes are most disliked by patients and to incorporate these preferences into the design of perioperative care.

Macario et al [1] obtained rankings for 10 states such as pain, nausea, somnolence and sore throat that might be experienced after general anesthesia from 101 patients prior to surgery using an anonymous questionnaire. They found that vomiting, gagging on the endotracheal tube, pain and nausea were the least desirable outcomes in descending order of importance. Subjects were asked to imagine that they had a fixed sum of money ($100) to spend on avoiding all of these states and to allocate all the money in proportion to his/her desire to avoid each state. The mean dollar value allocated to each state was taken to be the relative value of avoiding it. Subjects completed the questionnaires without direct assistance from the

investigators. Gan et al [2] obtained estimates of how much money post-surgical patients would have been willing to pay to avoid nausea and vomiting by administering a computer-based questionnaire. They found a median value of $56, and derived covariates (actual nausea, actual vomiting, increasing income, increasing age and presence of health insurance), which independently increased this amount. They did not examine other adverse postoperative states. Engoren and Steffel [3] asked 60 patients in the pre-operative holding area of their hospital to complete a questionnaire about their previous experience with five common post anesthesia side effects and how much they would be willing to pay to reduce or avoid such phenomena for their immediately forthcoming operation. Only about 25% of the group thought it worth spending hypothetical money to avoid nausea, emesis, sore throat, headache or pain, and the dollar values cited ranged widely.

We chose to try and validate and expand previous work in this field. Instead of an anonymous questionnaire-based design, we sought to maximize comprehension of and compliance with the study objectives by applying screening tests and performing standardized subject interviews. We also sought to obtain values for some adverse effects that had not previously been studied.

The specific objectives of this study were, by using a standardized interview technique, to

1. Obtain rankings of unpleasantness and relative values for nine known experiences known to be associated with general and regional anesthesia

2. Obtain the same values from a group of anesthesia providers and describe any differences

Methods

Ethics board approval was obtained, and written informed consent obtained from each participant.

Subjects

Surgical Patients

Almost all persons undergoing elective surgery at the University of Alberta Hospitals undergo preoperative evaluation in the Pre-Admission Clinic. The hospital's elective adult surgical repertoire consists almost entirely of major procedures, in a population with high co-morbidity. A 20% random sample of each day's clinic attendees was invited to participate in the study, by selecting from the day's schedule using a table of random numbers. Persons aged under 18, or who were not fluent in English were not approached. Data obtained from subjects who demonstrated difficulty understanding the study's core concept was discarded. This was determined by failure to correctly answer a screening question using the study's methodology applied to a fanciful scenario involving a tornado's effect on the subject's home (see Additional File 1:Appendix 1).

Anesthesia Providers

Each Staff and Resident member of the Department of Anesthesiology at the University of Alberta Hospitals was asked to participate.

Interview and Data collection

Subjects were interviewed according to a standardized written sequence (see Additional File 2:Appendix 2) by a single, trained interviewer. Demographic data, educational level, and in the case of the provider group, number of years of anesthesia experience, were recorded. Data concerning the subject's projected anesthesia plan or actual anesthesia course as a patient were not collected. Then, descriptions of 10 perioperative experiences (nine experiences of interest plus the normal state) were presented to the subject in random order, both verbally and written on file cards. The descriptions for 5 of these states were taken from a published study [1] ('nausea', 'normal', 'pain', 'somnolence', 'vomiting'). We chose these states because they were amongst the ones deemed most unpleasant in previous work. The other five (being intentionally awake during surgery, blood transfusion, postoperative myalgia, pruritus and urinary retention) were derived and refined by a focus group of three anesthesiologists from our department. These were chosen either because they each describe something that is associated with the regional anesthesia experience, or that can in theory be avoided or ameliorated by changes in anesthesia technique in some circumstances (table 1).

Subjects ranked the states in descending order of unpleasantness, and re-ranked them as they wished until they were sure of the desired order.

Thereafter, subjects were asked to imagine that they had a fixed sum of money ($100) to spend on avoiding any or all of these postoperative states. Subjects were asked to 'pay' to avoid each in proportion to his or her relative desire to do so. Zero ratings and tied ratings were explicitly permitted; Subjects were encouraged to reflect their own opinions. The interviewer was careful to remind the subjects that there was no true or correct answer, and requests for information about other subjects' ratings were declined. In the event of a finalized total allocation not equal to $100, the interviewer helped the subject adjust the scores, in proportion to those expressed, to total $100. When this was necessary, the interviewer took care to ensure that the ratio of the values for each state as expressed by the subject were preserved in the final values (for example, a subject who rated three states as $40, $25 and $15 and the remainder at $0 (total =$80) would have had

Table 1: Descriptions of Adverse Effects

Effect	Description
Awake During Surgery	You are lying on your back in the Operating Room. You are wide-awake. You cannot see the surgery, but you can see people moving around the room, and can hear everything that goes on. Your operation is going on but you cannot feel or move the part that is being operated on. There is no pain.
Blood Transfusion	You are in the recovery room. Your surgery is finished and you feel fine. You are told that you were given two pints of blood from the blood bank during the surgery because you needed it.
Myalgia	It is the day after your surgery. All your muscles ache for the whole day, as if you had flu. The ache gets worse when you try to move, but you manage to get around
Nausea	You are lying on your side, awake and aware of your surroundings in the recovery room. You are extremely queasy, as if you were on a boat in rough seas. The least movement makes the nausea worse
Normal	You are lying on your back, awake and alert. You feel no pain or nausea, feel good and are ready to go home
Pain	You are lying on your back, awake and aware of your surroundings in the recovery room. Your surgical incision really hurts, as if a knife was stabbing you. Movement makes the pain worse, and no position seems to make it better
Pruritus	You are sitting up in your hospital bed after the operation. You feel itchy all over and have to scratch yourself often.
Somnolence	You are in the recovery room and are drifting off to sleep even though you want to stay awake. You are unable, despite your best effort, to stay awake long enough to tell the nurse how you are feeling
Urinary Retention	You are in the recovery room, awake and alert. You want to pass urine (water) but no matter how hard you try, none comes out
Vomiting	You are lying on your side, awake and aware of your surroundings in the recovery room. You feel waves of nausea and are throwing up. Your abdominal and chest muscles ache from vomiting

these responses adjusted to final scores of $50, $31.25, $18.75 and the remainder at $0 (total=$100). In this manner, we sought to arrive at relative, (but not absolute) indices of unpleasantness for each of these states.

Statistical Analysis

Data was entered in to a computerized spreadsheet and a 10% random sample was crosschecked independently for coding errors. Statistical analysis was performed using SAS version 8. Frequency distributions for the outcome variables were described using modal scores for the ordinal rating of each effect, and median values and interquartile ranges for the relative value of each effect. Congruence between the rating and relative value attributed to each effect was measured by Pearson's rank correlation coefficient. Comparisons of effect magnitude between subgroups was performed using 2-sided Wilcoxon's Rank Sum Tests and a significance level of 0.05.

Results

Subject flow

One hundred and thirty-one surgical patients agreed to participate. Sixteen subjects did not understand the screening questions or gave incorrect answers to them, four interviews were terminated in order to avoid delaying the subject's progress through the clinic, one subject became acutely unwell, and one withdrew without stating why. One subject passed the screening test, and was able to provide ratings, which were used, but not relative values for the perioperative experiences. Thus, 109 patient subjects completed the study. Their demographic characteristics are shown in table 2. Those who did not complete the study were more likely to be over 65 (65% vs 28%, p = 0.001) than those who did, but educational levels did not differ. Data was obtained from all 30 anesthesia providers approached out of an available pool of 35 and was complete in every case.

Demographic data

Both genders, all adult age groups and educational levels were represented in the subject group:

Ranking of Perioperative experiences

Figure 1 shows the frequency distribution of the ranking for each effect. Table 3 shows the order in which the group ranked the effects in descending order of unpleasantness, and the relative value attached to each, as estimated by the median fraction of $100 that the group was willing to pay to avoid it

In the subject group as a whole, pain was felt to be the most important thing to avoid. Vomiting came second, but the value to subjects of avoiding vomiting was of the same order of magnitude ($20 vs $25). Avoiding nausea was half as valuable as avoiding vomiting, and 40% as important as avoiding pain. Subjects placed at least some value on avoiding urinary retention, myalgia and pruritus, but none, in the aggregate, on avoiding blood transfusion, having an awake anesthetic technique or somnolence in the recovery room. The (hypothetical) completely normal state was, as expected, rated as the most desirable, and no one was willing to pay to avoid it.

Table 2: Demographic characteristics of subjects

	Surgical patients (n = 109)	Anesthesia providers (n = 30)
Male gender	59 (54%)	22 (73%)
Age 18–35	24 (22%)	11 (37%)
36–64	55 (50%)	19 (63%)
65+	30 (28%)	0
Education		
12 or less	65 (60%)	-
Beyond grade 12	44 (40%)	-
Anesthesia provider experience		
Less than 8 years	-	15 (50%)
8 years or more	-	15 (50%)

Table 3: Ranking and relative values of adverse effects.

Adverse effect	Modal ranking	Number of subjects ranking this as the most unpleasant adverse effect	Relative value ($) – median	Relative value ($) - interquartile range
Pain	1 (most unpleasant)	68 (49%)	25	17–40
Vomiting	2	33 (24%)	20	10–25
Nausea	3	4 (3%)	10	4–20
Urinary retention	5	4 (3%)	5	0–14
Myalgia	5	1 (1%)	2	0–8
Pruritus	6	1 (1%)	2	0–8
Blood transfusion	8	6 (4%)	0	0–10
Awake during surgery	9	22 (16%)	0	0–11
Somnolence	9	0	0	0–2.5
Normal	10 (least unpleasant)	0	0	0–0

In general, gender did not make a difference in effect ranking or relative value, but there was one exception; men attached a higher value to avoiding urinary retention than women (median $9.50 vs $1.50, $p < 0.0001$).

Subjects aged 65 or older attached no value to avoiding a blood transfusion, while younger subjects did ($0 vs $2.50, $p = 0.002$). There were no other age-related differences. Educational level (whether or not the subject had been educated beyond high school) did not affect ratings. Anesthesia providers rated and valued effects no differently from surgical patients, and being a provider with more experience made no difference. We did not collect data on previous surgical or anesthetic experiences because a previous study in the area did not show these factors to affect preferences [1].

For the most part, strong correlations were found between the ranking of an experience and the amount of money the subject would have paid to avoid it (Table 4). These correlations are negative, since subjects assigned the most unpleasant effects the lowest rank order number but assigned them the largest sums of money.

Discussion

Our data confirms the ability of surgical patients to quantify their preferences for perioperative experiences resulting from anesthesia and surgery.

Patient satisfaction with anesthesia is a complex and highly individual construct [4]. However, it seems logical to assume that in a situation where a variety of safe and effective techniques or drug sequences are available that anesthesia experiences that minimize the adverse effects the patient fears the most will be the most favorably received. We have made quantitative estimates of how a presurgical population at a tertiary-care Canadian teaching hospital values a selected range of perioperative experiences. The summary data should be viewed in the context of wide variation in certain areas (figure 1). This reflects the fact that these are individual choices, which will necessarily be influenced by many factors not quantified

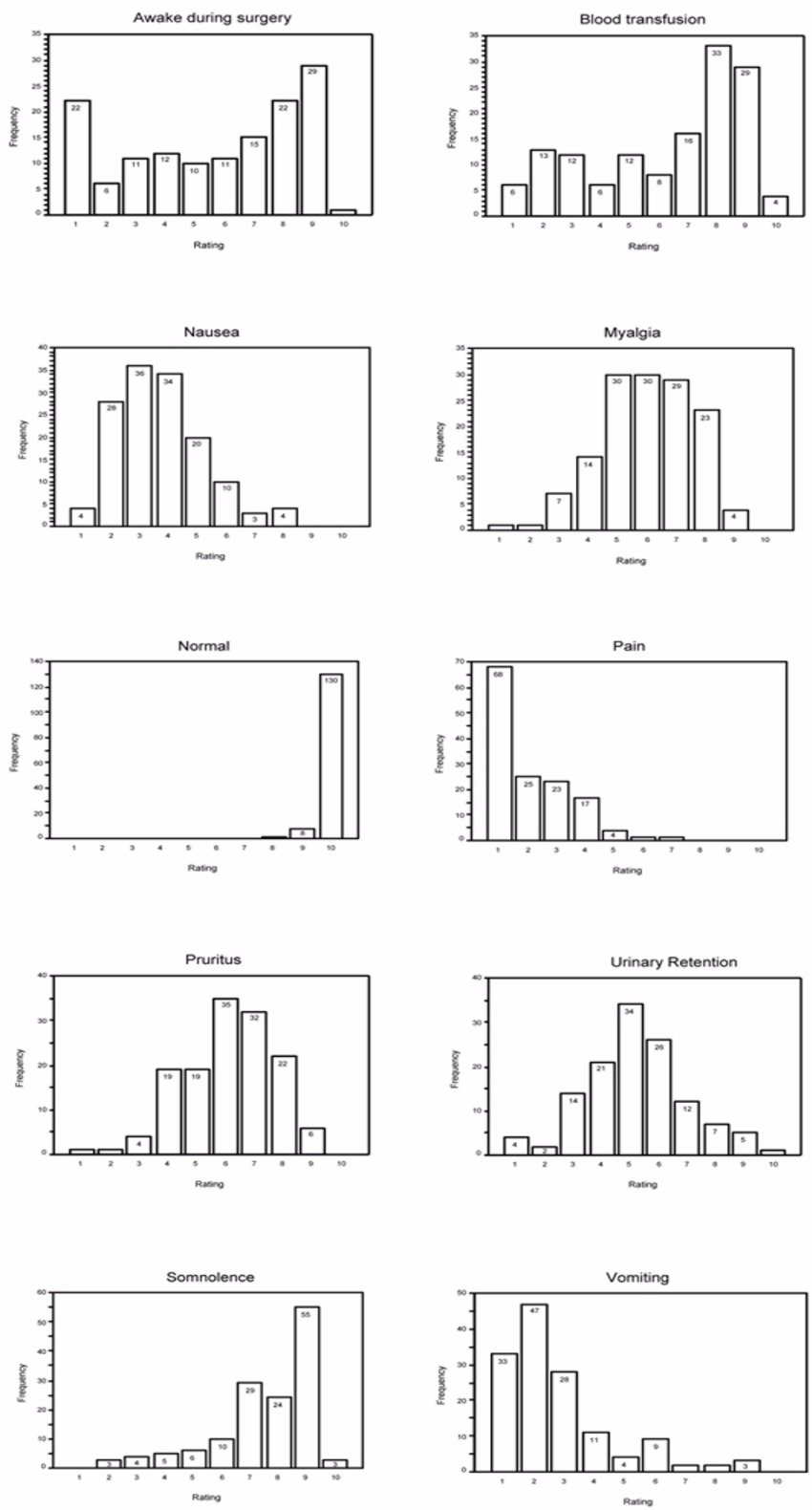

Figure 1
Rating of individual states (1 = most unpleasant, 10 = least unpleasant)

Table 4: Correlation between effect rank and relative value for adverse effects

Adverse effect	Pearson Correlation coefficient	p
Pain	-0.67	<0.0001
Vomiting	-0.61	<0.0001
Nausea	-0.70	<0.0001
Urinary retention	-0.67	<0.0001
Myalgia	-0.55	<0.0001
Pruritus	-0.60	<0.0001
Blood transfusion	-0.74	<0.0001
Awake during surgery	-0.74	<0.0001
Somnolence	-0.50	<0.0001
Normal	-0.21	0.015

here, such as personality and past experience. Nonetheless, trends are clearly visible, and by using medians and non-parametric statistical tests, we have attempted to reflect the feelings of the bulk of the sample and minimize the effect of outliers.

Pain was the most feared effect in our subject group. Subjects allocated a quarter of their available imaginary resources to preventing it. In recent years, the effective treatment of post-surgical pain has become a major objective of many anesthesia departments, and our results would appear to indicate that this is time and effort appropriately spent. Interestingly, many of our subjects rated vomiting as being worse than pain. In fact, only 62(45%) of the group gave pain a worse value than vomiting: 47(34%) valued pain and vomiting as equally bad and 29(21%) were prepared to pay more to avoid vomiting than pain. If the values for nausea and vomiting are summed, 71(51%) subjects valued prevention and treatment of nausea and vomiting more highly than the treatment of pain. In the work of Macario et al[1] vomiting was actually the most feared outcome, although the relative values allocated to the treatment of vomiting and pain were similar ($18.05 +/- 1.09 and 16.96 +/- 1.59 respectively). This suggests that we should expend as much effort in the prevention and treatment of nausea and vomiting as we do for pain, something that most anesthesia services, including our own, would find hard to claim.

Three other perioperative experiences were also given non-zero median values: urinary retention, myalgia and pruritus but the values were an order of magnitude smaller than pain or emesis.

We were surprised to find that the avoidance of a blood transfusion was, in the aggregate, not felt to be worthy of expenditure in the context presented, although the bimodal shape of the rating curve suggests that for some people, this is an important issue. Although we did not offer subjects a list of risks and rates for the various potential complications of blood transfusion, we think it unlikely that subjects were entirely unaware of this, given the amount of attention that Canadian society has paid to this topic recently [5]. This result may reflect high confidence in our ability to minimize these risks. Alternatively, since we have derived relative, not absolute values for avoiding the perioperative experiences in question, it is possible that avoiding blood transfusion would have accrued more value if we had offered it alongside a range of less important choices.

The rating of 'being awake during surgery' also has a bimodal distribution. Although the state was given a low overall relative value, 16% of subjects ranked it as the most unpleasant thing. Despite careful explanation, we may have failed to adequately specify that the question related to being *intentionally* awake, as part of an anesthetic technique in which the body part being operated on is insensate. Some subjects may have confused this with intraoperative awareness, a catastrophic complication of general anesthesia in which inadequate anesthetic depth goes undetected, yet evasive motor response is made impossible by the use of muscle relaxant drugs. An alternative interpretation is that, the absence of pain notwithstanding, the idea of seeing and hearing the activity of the operating room is noxious to some people. Clinical experience supports the idea that some people find the idea of awake surgery very hard to accept.

There is evidence that our results are internally consistent. An outcome free of adverse effects was rated as the most desirable, as one would have expected, and the adversity rating of a given effect was strongly correlated with the amount of money a subject would have paid to avoid it. A measure of external consistency is the way in which our results are comparable with previous work in the area, from which we reproduced the written descriptions of five of the effects. Table 5 compares the relative values for four of

Table 5: Ratings for four adverse effects common to the present study and that of Macario et al

	Present Study		Macario et al [1]	
Effect	Mean relative value ($/100)	Standardized relative value (Somnolence = 1.00) Mean (SD)	Mean relative value ($/100)	Standardized relative value (Somnolence = 1.00) Mean (SD)
Somnolence	2.19	**1.00 (2.44)**	2.69	**1.00(0.93)**
Nausea	12.76	**5.80(4.80)**	11.82	**4.40(3.25)**
Vomiting	19.41	**8.87(6.32)**	18.05	**6.70(4.07)**
Pain	29.16	**13.3(8.50)**	16.96	**6.30(5.94)**

the five perioperative experience descriptions which were common to both studies, expressed as multiples of the value of the effect given the smallest non-zero rating (somnolence). (Mean values are reported for the present study, not medians as in the previous tables, in order to conform to the report of the other study). The differences between the two study populations are not different ($p > 0.05$ by t-test), suggesting reliability of the method.

The lack of difference between anesthesia provider and surgical patient values suggests that we are sensitive to our patients' needs in this regard. It would be unfortunate if the necessary time to discuss these and other issues with patients prior to surgery were to become excessively eroded as patterns of surgical care delivery change to promote the ever more efficient use of resources.

Among the limitations of the method we used is the idea that the $0–$100 framework for expressing relative value may have been too restrictive. In order to value a given effect as more than 100 times worse than another, for instance, it would have been necessary to choose fractional dollar amounts. While this was allowed, few subjects chose this option. The maximum relative value difference allowed in our study would have been $99.99 vs $0.01, but there were no such choices. In addition, since the dollar amounts expressed had to add to $100, this was not a true 'willingness to pay' study, a technique that allows subjects (and therefore health care providers and industry) to determine the market value of an intervention[6]. Our results say little about how much real money one of our subjects would have been willing to spend to avoid, say, perioperative vomiting, and still less about how much another patient, one outside our fully-funded open access system, would approach the same choice if it were available. However, since the values expressed by our subjects were expressed using hypothetical dollars, our results are unlikely to have been influenced by the subject's financial circumstances, an important limitation of willingness to pay studies[7]. We may have come closer to asking 'how important is this adverse effect to you ?' rather than 'what could you afford to pay to avoid this adverse effect ?' by choosing this approach.

Patient satisfaction is, of course, only one part of the anesthesia decision algorithm. This is exemplified by the non-zero relative value ($2) of avoiding postoperative myalgia. Taken in isolation, this might be said to argue for the exclusion of the depolarizing muscle relaxant succinycholine, a strong risk factor for postoperative myalgia [8] from anesthetic regimens. However, the practitioner must balance this against the relative risk of an airway problem or the effect on case throughput of prolonged curarisation if an alternative relaxant is used. Another illustration of this need to view all relevant aspects comes from the zero value given to avoiding postoperative somnolence. This might suggest that newer, more expensive anesthetic agents, which are used on the basis that recovery will be faster [9], are unnecessary, but this ignores any safety enhancement that might accrue from having a more awake patient in the recovery room, or the economic benefits of faster discharge. Whether utilizing anesthesia techniques that incorporate individual patient preferences results in improved function or quality of life in the postoperative period is not known.

We did not evaluate catastrophic or very rare events, believing this to be too burdensome and upsetting for our pre-surgical population. However, the quantification of the relative value of avoiding such events would be necessary if decision analysis of anesthetic choices were to be fair. Catastrophic yet very rare outcomes might, by their values alone, substantially influence decision tree outcome. It may be that values provided by anesthesia providers would suffice, since this study indicates that in general, anesthetists and patients report similar values.

We regard this as an early step on the road to incorporating patient preferences into anesthetic decision-making. If fair comparison is to be made between anesthetic regimes then a comprehensive list of perioperative experiences attributable to each technique must be available, and contain absolute values for patient preference. Choosing the best anesthetic, from the patient's point of view at least, then becomes amenable to formal decision analysis. Absolute values, or utilities, for perioperative experiences must, in general, be obtained using so called 'standard gamble' questioning[10], and this has yet to be done in pre-surgical patients. We concur with previous workers in this area in suggesting that that quantification of patient preference for perioperative experiences is reliable.

Anesthesia providers are charged with the responsibility of choosing the best anesthetic for the patient. This choice may, in certain circumstances, have little or nothing to do with patient preference (for example, in the case of a potentially difficult airway which must be secured prior to induction of general anesthesia for safety). Our study shows that in less extreme circumstances, the shared decision making dialogue that currently takes place between provider and patient is amenable to quantitative preference analysis. Incorporating these preferences will better enable us to state that, within the limits of the technology available, and subject always to considerations of safety, we are anesthetizing our patients in the way which suits them best.

Competing interests

None declared.

Authors' contributions

SR designed the study, analyzed the data and wrote most of the manuscript. PB contributed to the design of the interview tools, recruited subjects, performed the interviews and contributed to the writing of the manuscript

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