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Editorial

Beware the Boojum: the NAP5 audit of accidental awareness during intended general anaesthesia

They sought it with thimbles
they sought it with care;
They pursued it with forks and
hope;
They threatened its life with a
railway-share;
They charmed it with smiles and
soap

–Lewis Carroll
The Hunting of the Snark

The 5th National Audit Project (NAP5) of the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland has achieved another important milestone with the publication of the NAP5 results. Like its NAP predecessors, NAP5 has been an impressive logistical undertaking with prospectively obtained national data from the UK and Ireland over a period of a year. The results of the NAP5 audit have been summarised in three papers published in this edition of *Anaesthesia* [1–3] and simultaneously in the *British Journal of Anaesthesia*, with a summary of the Irish data also recently published [4] and the full report available online (see http://www.nationalauditprojects.org.uk/NAP5_home). This work certainly adds information to the body of knowledge about intra-operative awareness with postoperative recall, and contains the elements to forge a definitive approach to the problem of accidental awareness during intended general anaesthesia (AAGA; Fig. 1). In particular, it provides a wealth of information about the subjective experiences of patients and the interactions with the staff, and develops some useful guides for clinical practice – both to avoid AAGA and in the mitigation of the effects of AAGA. Because the individual anaesthetist will not encounter many patients who have suffered AAGA, we encourage reading the case vignettes to get a clear idea of the wide range of awareness experiences that have been reported by different patients. The NAP5 awareness support pathway provides a framework for the sort of interventions that could be helpful when a patient reports AAGA.

The investigators suggest a human factors/root cause analysis to guide investigations into the reasons for cases of AAGA. It is noteworthy that there were a plethora of probable contributory factors, without any one in particular standing out. Interestingly, most cases of AAGA were judged by an independent panel as potentially preventable. However, hindsight can sometimes yield apparent clarity, obscuring the nuanced reality that typically characterises clinically complex situations. For example, it might be true that administering additional propofol during an unexpectedly prolonged and difficult intubation attempt in a shocked patient could prevent AAGA. But when a patient's life depends on the establishment of a secure airway and prevention of cardiovascular collapse, these pressing considerations trump secondary concerns about prevention of AAGA. However, what NAP5 does clarify is that, of the patients who suffered subjective distress during the AAGA, almost 80% went on to suffer long-term debilitation – as against only 3% of those who did not find the AAGA episode distressing. The experience of paralysis (and difficulty in breathing) was pre-eminent in causing distress. It is concerning that many of the patients who were very distressed often waited a long time before reporting the AAGA experience.

The quantitative aspects of the NAP5 report are potentially problematic, and need to be interpreted with caution. Contrary to the common medical research mantra, increasing the size of a study does not necessarily produce more accurate estimates if there are intrinsic statistical biases in the

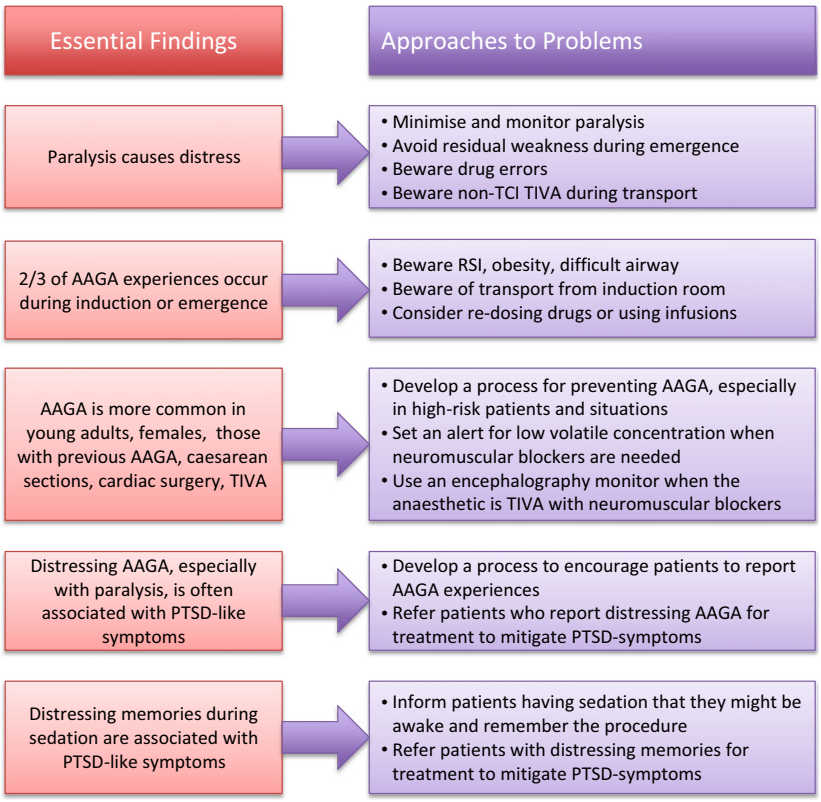

Figure 1 Essential findings of the NAP5 audit with elements of a comprehensive approach to the problem of accidental awareness during intended general anaesthesia (AAGA). PTSD, post-traumatic stress disorder; RSI, rapid sequence induction; TIVA, total intravenous anaesthesia; TCI, target-controlled infusion.

study. Both the numerators and the denominators in this study are open to extensive bias. Intrinsically, reports of AAGA are reliant on a tortuous chain of memory and consciousness within the patient, and a suitably receptive healthcare system to detect and diagnose each of the cases. Both false negatives and false positives occur at all stages in the process. Unfortunately, a gold standard for detecting AAGA does not exist. Targeted questioning, like the Brice interview, is theoretically open to the possibility of helping to make half-formed implicit memories become explicit, or even the generation of false memories. However, the reliance on self-reporting is also biased. As the authors discuss, patients may fail to report an incident of AAGA because their experience was either too trivial or too horrendous. It is not correct to claim that the non-interventional approach ('unprovoked by active questioning') used in this audit is 'robust': it is anything but. The reports were arbitrarily triggered by media publicity, or the patient's coming to pre-admission for a second anaesthetic, or even simply chatting with a friend. This is neither a random sample nor a proper census. A salient study by Mashour et al. exposed the unreliability of spontaneous reports of AAGA [5]. In this study of a large unselected surgical population, the incidence of 'definite' AAGA using a single Brice questionnaire at one month postoperatively was 19 per 18 836 or 0.1%, with almost twice as many patients (37) experiencing 'definite or possible' AAGA (0.2%). In stark contrast, a review of quality assurance records revealed that only three of the 19 patients with 'definite' AAGA in this population reported their experience on routine postoperative interview, for an incidence of 3 per 18 836 or 0.02% [5]. Importantly, patients from this population who were judged from Brice interview responses to have experienced 'definite or possible' AAGA were at increased risk for experiencing

persistent post-traumatic stress disorder-related symptoms.

Similarly, the denominator (total number of general anaesthetics) is unclear from the NAP5 results. It is indirectly inferred (with an undisclosed percentage error) from the activity surveys [6, 7], and is further complicated by the fact that almost a quarter of the cases (35/141) actually occurred before the study commenced, but had not been previously reported to a health professional. In essence, the investigators were sampling from the population of all general anaesthesia survivors from 1946 to the present, who had not previously reported any intra-operative recall, and who had also chanced to be exposed to the investigation team. Despite the lack of a gold standard, our opinion is that studies that have systematically questioned every patient in the populations studied [8–13] are likely to have produced more accurate estimates of AAGA incidence than the nationwide NAP5 audit. There is potentially a big difference in reliability in an audit project that depends on reports that can be provided relatively accurately by clinicians (e.g. failed intubation) compared with an approach that depends on reports that require spontaneous patient initiation. For all these reasons, the estimates of an incidence of AAGA based on the NAP5 results lying between 1:6000 and 1:20 000 are likely to be inaccurate. Taking the NAP5 results in the context of other recent studies, we agree that it is appropriate to convey the message that modern anaesthetic techniques usually succeed in preventing AAGA. However, it would be regrettable if, based predominantly on NAP5, the public and the medical community were falsely reassured about a vanishingly low incidence of AAGA [14].

Despite the caveats regarding the incidence of AAGA inferred from NAP5, we believe that there are a number of important clinical lessons that can be learnt or reinforced from these data (Fig. 1). One of the most compelling concepts expressed by the investigators is that "*it is clear that the sensation of paralysis is a novel one with capacity to cause great psychological harm, unless it is counteracted by general anaesthesia*" [2]. Conversely, AAGA without paralysis seldom results in psychological distress. From this, several take-home messages follow. First, avoid or minimise the use of neuromuscular blocking drugs. Second, routinely guide the minimisation of neuromuscular blocking drugs with a peripheral nerve stimulator. Third, antagonism of neuromuscular blocking drugs should almost always be administered, and should be administered before decreasing anaesthetic concentration near the end of surgery. Fourth, if neuromuscular blockade is needed for the surgery, set alerts for low volatile anaesthetic concentrations and routinely use a processed electroencephalograph monitor if total intravenous anaesthesia is administered. Another important finding in the NAP5 reports is that many AAGA experiences occur during the dynamic phases of general anaesthesia, namely induction and emergence. Rapid sequence induction in particular appears to increase the risk of AAGA.

Unexpectedly, sedation turned out to be a Bandersnatch: NAP5 has highlighted major problems with patients' understanding of what sedation involves. This echoes the finding of the American Society of Anesthesiologists' Anesthesia Awareness Registry, which found that patients who experienced unexpected recall following procedural sedation reported comparable distress and had a similar rate of persistent psychological sequelae to those who reported AAGA [15]. The common promise of "I will give you a drug that removes the memory of the procedure" is a set-up for failure. The authors provide a very useful table that accurately describes what patients can expect from various levels of sedation, and suggest that this could be the basis of better informed consent processes.

In summarising, the main value of the NAP5 project is that it points specifically to deficiencies in current practice and suggests ways in which care can be improved. In relation to detection of AAGA, given its probable rarity, rigorous screening for AAGA among all surgical patients is arguably not practical or warranted. Regarding prevention of AAGA, the investigators propose a modification to the World Health Organization Surgical Safety Checklist. But given the low incidence of AAGA, this further imposition on clinicians' time might not be the most efficient intervention. Simple changes in standard anaesthesia practice, such as routine setting of low volatile agent alarms and use of electroencephalography monitors when patients receive total

intravenous anaesthesia with neuromuscular blockade, might prove more effective. Patients can be reassured that AAGA is a rare complication and that we have evidence-based approaches to decrease its likelihood. Patients who are receiving sedation should be told unambiguously that general anaesthesia is not intended, awareness is common, and many patients retain memories despite receiving amnesic medications. Patients should be encouraged to report AAGA experiences to clinicians and a process should be established to offer appropriate care to patients who complain of distressing AAGA, as this is frequently complicated by persistent symptoms of post-traumatic stress disorder, and the outcome can be improved with interventions such as cognitive behavioural therapy.

Perhaps the occurrence of AAGA can be thought of in similar terms to Lewis Carroll's Snarks. Most Snarks go undetected even if we hunt for them; these are cases of AAGA without postoperative recall, where no clinical significance of the awareness has been established. Many Snarks can be discovered when sought, but often cause no disruption; these are compelling descriptions of AAGA, which are not necessarily distressing to patients. But occasionally a Snark turns out to be a Boojum – a distressing AAGA experience, typically associated with neuromuscular blockade, that can have debilitating and long-lasting psychological consequences.

Competing interests

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