CHAPTER
10

AAGA during extubation and emergence


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HEADLINE

10.1 Almost a fifth of the reports received by NAP5 occurred during emergence, and 85% of these patients experienced the distress of paralysis while awake. The Panel judged 88% of cases as being potentially preventable with appropriate use of a nerve stimulator, better communication, and maintenance of anaesthesia until full reversal of neuromuscular blockade. In a third of cases communication failure within the team highlighted poorly-judged selection, dose, or timing of neuromuscular drugs. In all except one case airway management was with a tracheal tube. Lack of education about the rapid offset of newer volatile agents was cited as contributory in some cases. As elsewhere, these cases highlight the fact that adverse outcomes were more often associated with the use of neuromuscular blocking drugs.

BACKGROUND

10.2 Induction of anaesthesia underwent a sea-change after the introduction of thiopentone so that inhalational induction became almost restricted to children or those with fear of needles. The conduct of extubation and emergence has changed gradually so that awake extubation (including removal of supraglottic airways) is now common; a practice that has recently been actively advocated in authoritative guidelines (Popat et al., 2012). The introduction of propofol in the 1980s, the introduction of volatile agents with lower blood gas solubility accelerating emergence, and the use of the laryngeal mask instead of the tracheal tube have all facilitated this change.

10.3 The much faster emergence seen with propofol, sevoflurane or desflurane means that some vague recall of recovery has perhaps become normal, and the experience of expelling a laryngeal mask or receiving oxygen in part remembered. In the authors' experience older patients recall induction with 'gas', but now some patients report that "*something must have gone wrong; I woke up with oxygen on*". Publications on patient experiences in recovery are scarce, but have sought to develop objective scores relating to patient support, comfort, emotions, physical independence, and pain (Myles et al., 2000; Faleiro & Sinclair, 2006; Gornall et al., 2013).

10.4 More rapid emergence and re-acquisition of airway reflexes has reduced the risk of laryngospasm (historically a barrier to attempting awake extubation). Although awake extubation was described by Bourne (1947), the majority of elective surgical procedures at that time were followed by extubation under deep anaesthesia and spontaneous breathing. Only patients with 'full

stomachs' had their trachea extubated awake, and these while in the recovery position and head down (Wylie & Churchill-Davidson, 1972; Atkinson et al., 1982).

10.5 Developments in anaesthetic drugs and anaesthetic practice have been followed by pressures to increase numbers of day-case surgeries, improve theatre turnover and champion enhanced recovery. All these have driven processes that emphasise theatre efficiency, rapid transit through recovery and early resumption of normal patient activities. These have been in turn supported by an increased tendency to manage the airway with the less invasive supraglottic airway, or to extubate the patient already 'awake' before handing their care over to the recovery nurse for a briefer period.

10.6 Most recently, the Difficult Airway Society published comprehensive guidance which included the need to plan for extubation and to reverse or antagonise neuromuscular blockade before allowing the patient to awaken (Popat et al., 2012). In these guidelines, awake extubation is emphasised as the default method, with 'asleep extubation' generally reserved for low-risk cases with specific indications.

10.7 The availability of shorter-acting neuromuscular blockers with rapid offset times (e.g. mivacurium) and temptingly simple pharmacological elimination (e.g. atracurium, cis-atracurium) also played a part in the change to awake extubation (something probably more difficult with drugs such as pancuronium). Improved efficiency of reversal of neuromuscular paralysis with sugammadex has provided another tool in the armamentarium of rapid emergence from anaesthesia and paralysis.

10.8 With patients more frequently awake at extubation as a result of these changes in practice, it might reasonably be predicted that recall of this phase of anaesthesia would also become more common.

10.9 Anaesthetists have been reported as reluctant to communicate detailed information to patients about anaesthesia, perhaps through concern about heightening patient anxiety (Gillies & Baldwin, 2001). Explanation of emergence and recovery room experience was minimal and tracheal extubation was almost never mentioned (Oldman et al., 2004). More recently this haphazard approach has been improved and patient information booklets have come into widespread use (e.g. RCoA, 2008). Provision of such information prior to anaesthesia is now as a result an expected standard of care. The extent to which these documents describe emergence, extubation and recovery is, however, sparse. Predictably therefore, experience of extubation and recovery may be interpreted by patients as part of surgery.

10.10 As noted in Chapter 6, Results, emergence is a dynamic process and 'full emergence' is difficult to pinpoint which, not only means that this is a period when unintended (or unrecognised) wakefulness may occur, but also means that it is difficult to define. For the purposes of NAP5, emergence was defined as any time after the end of surgery, when the patient reported they were awake when they felt they should still have been unconscious. This definition – emphasising the patient's perspective for purposes of reporting and analysis – focuses on aspects of emergence which cause potential distress or dissatisfaction. It also enabled us to include cases where drug errors or failure to reverse neuromuscular blockade caused paralysis (and hence perceptions of AAGA) in the recovery period.

NAP5 CASE REVIEW AND NUMERICAL ANALYSIS

10.11 Of the 141 reports assessed by the Panel as Certain or probable, 26 cases (18%) involved the emergence phase (one involved both maintenance and emergence; two involved both induction and emergence). In a further three cases (not included here) there was doubt as to the exact phase of AAGA, but emergence may have been involved. In several cases (several included here but also some excluded) it was difficult to judge whether recalled events related to emergence or events in recovery after emergence.

10.12 In line with the proportions reported in the Activity Survey, 17 (65%) were reports from women and nine (35%) described immediate or urgent care. Body habitus was known in 22 patients: of these eight (36%) were obese, five (23%) overweight, eight (36%) normal weight, and one (4%) was underweight. All but one (96%) received neuromuscular blockade.

10.13 Airway management was with a tracheal tube in 21 patients (81%) and awake extubation was planned in 16 of these (asleep extubation was planned in one and in five the decision was unclear). In three reports extubation was not planned and the report related to transfers after the end of surgery. In one, a supraglottic airway was used.

10.14 An anticholinesterase (reversal) drug was administered to 11 patients of the 19 (57%) who had received non-depolarising agents other

than mivacurium. A nerve stimulator was used in only six (24%) patients who had received neuromuscular blockade. Inappropriate reversal was not used in those patients who had mivacurium or suxamethonium alone. No patient received sugammadex.

10.15 The predominant symptom was paralysis, which was distressing. Of the 26 patients, 22 (84%) reported paralysis. Only four patients did not find paralysis distressing. Two patients reporting distress only felt touch (the tracheal tube or laryngeal mask), rather than the sensation of inability to move that was felt by the majority. Two patients specifically reported a sense of suffocation and terror. However, the longer term impact in terms of the modified NPSA score (median 1.5 (interquartile range 0.75–2.25), range (0–3) was modest.

A young patient woke rapidly after elective surgery, was extubated in theatre but had residual weakness in recovery. Three days later the patient described "waking up with the tube in" and being unable to speak. There was paralysis, difficulty moving the jaw or swallowing and the experience lasted about five minutes. After a technique employing diazepam premedication, propofol, fentanyl, and vecuronium for tracheal intubation, maintenance was with a volatile agent. Awake extubation was planned, so neostigmine administered but no nerve stimulator was used to check its effect. Further neostigmine was administered in recovery after the problem of inadequate reversal was recognised on the anaesthetic chart.

10.16 Of the 26 cases, 23 (88%) were judged preventable. One was deemed not preventable, and in two cases, poor charting prevented a judgement. In 11 cases (42%) the absence of, or failure to use, a nerve stimulator was identified by the Panel as contributory or causal. In six (23%) patients the Panel judged that the neuromuscular blocker had been administered too close to the anticipated end of surgery, had been ill-chosen for the duration of the procedure, or had been given in too great a dose for the procedure. In another six, reversal appeared to have been given only after the patient exhibited signs of residual paralysis.

Almost a quarter of episodes of AAGA were reported to occur during emergence or in recovery

A young patient underwent oral surgery. They reported being awake but paralysed at the end of surgery and hearing voices calling their name. They tried to be logical and work out what was happening, but heard staff mention something to 'bring them round'; the patient assumed this was a defibrillator and panicked. Staff noticed the patient crying and administered reversal. The anaesthetic was induction and maintenance with TCI propofol and remifentanil and atracurium used before intubation. Neostigmine was administered at the end of the procedure but timing in relation to stopping the propofol was unclear. The LC's report states that a nerve stimulator and further neostigmine were used after the potential for AAGA was recognised; this was on the anaesthetic chart.

10.17 In eight patients (30%) communication between anaesthetist and patient, between anaesthetist and surgeon or between two or more anaesthetists, was assessed as causal/contributory to the episode of AAGA. In one case, the surgeon informed theatre staff that the operation was 'finished' when in fact the operation continued; in another, an anaesthetic trainee felt that the consultant had given instruction to reduce the anaesthetic delivery early towards the end of the case. Apparent unfamiliarity with the speed of offset of short acting agents (e.g. desflurane) was cited in four cases and distraction (from handovers or from involvement of other anaesthetists present) in another four.

Mistimed, poorly monitored or unreversed neuromuscular blockade was the predominant cause of AAGA at emergence

10.18 The most common neuromuscular blocker used (19 (73%) reports) was a non-depolarising agent alone; in a further five cases its use followed suxamethonium. Atracurium was used in 15 (58%) patients, mivacurium in five (19%), rocuronium in three (12%) and vecuronium and suxamethonium in a single case each. The distribution of NMBs in general use was not collected by the Activity Survey. There was reference to genetic testing in three patients who received mivacurium and experienced prolonged blockade. In one patient there was possibility of dual block.

A frail elderly patient with multiple co-morbidities underwent a brief expedited procedure. Induction was with remifentanil, propofol and mivacurium. Maintenance was with sevoflurane then desflurane in oxygen/air with ventilation through a SAD. After surgery the patient appeared 'slow to wake up'. Mivacurium apnoea and awareness were suspected and a nerve stimulator was then used only after the suspicion to confirm this. Anaesthesia was re-commenced and the patient was extubated some hours later. The patient remembered feeling unable to move or communicate, but thought "I'll come round soon". The experience lasted about a minute and the patient did not feel overly distressed. A full explanation was given, but some slight psychological distress persisted.

10.19 Only one patient who received no neuromuscular blocker made a report of AAGA at emergence.

A young elective day-case patient for a minor procedure reported an experience of awareness to an anaesthetist. The patient remembered having something in their mouth and not being able to breathe, then recalled waking up. The experience was brief (seconds to minutes) but the patient had nightmares for three nights afterwards and was scared the same thing would happen again. The technique used was propofol, cyclizine, and alfentanil with airway management by SAD. The volatile agent used was not named, but MAC values of ~1.2 were recorded. The inability to breathe might represent obstruction rather than paralysis, but could represent a catatonic-like reaction to cyclizine.

10.20 In summary, the Panel assessed 23 reports (88%) as being potentially preventable with appropriate use of a nerve stimulator, better communication, and maintenance of anaesthesia until full reversal of neuromuscular blockade. Education was cited as contributory in several reports, mainly related to knowledge about the variability of duration of neuromuscular blockade, the rapidity of offset of newer volatile agents, and the need to fully explain the experience of planned awake extubation. The apparent failure to investigate the possible genetic cause of prolonged neuromuscular blockade in some of the patients who received mivacurium or suxamethonium was disappointing.

A young fit patient after emergency abdominal surgery reported hearing stapling of the skin and was paralysed and unable to move or communicate. The patient recalled a conversation about his sweating and this all lasted from skin closure to extubation; about 30 min. The patient was distressed, unable to sleep on the first post-operative day and had unpleasant dreams. The desflurane vaporiser was turned off prematurely at the end of surgery.

10.21 In several instances, verbal reassurance provided to, or heard by, the patient during emergence appeared to probably mitigate adverse longer-term impact.

The patient's episode of awareness started in recovery after surgery. The patient was unable to cough, talk, move their limbs and open their eyes (as they were taped shut). The patient experienced ear/neck pain and the sensation of leg swelling. When a relative came to visit, the patient could hear the anaesthetist providing an explanation and reassurance about the problem. At this time the patient felt reassured.

DISCUSSION

10.22 There are considerable similarities between this group of reports of AAGA at emergence/extubation and those caused by syringe swap/drug error (i.e. Class G) discussed in Chapter 13 (Drug Error). In the latter group, patients were invariably aware but paralysed without anaesthesia as a result of inadvertent administration of a neuromuscular blocking drug. In the emergence reports, patients are invariably aware and paralysed as a result of inadvertent mismatch between the time course of return of consciousness *versus* the return of motor capacity. In both groups the prevalence of distress is very high, because the sensation of paralysis is highly unusual and leads to ideations of loss of control, or fear that something terrible is about to happen (see Chapter 7, Patient Experience).

10.23 Yet, of note, and in contrast to the 'pre-induction' drug swap cases (which had the highest modified NPSA scores of any group in NAP5), the cases occurring during emergence had low modified NPSA scores, indicating that marked psychological morbidity was uncommon (Figure 10.1). One explanation might be that relatively prompt recovery from residual anaesthesia in this group mitigated patient experiences and sequelae, but this is speculative.

Early cessation of short acting drugs was associated with AAGA during emergence

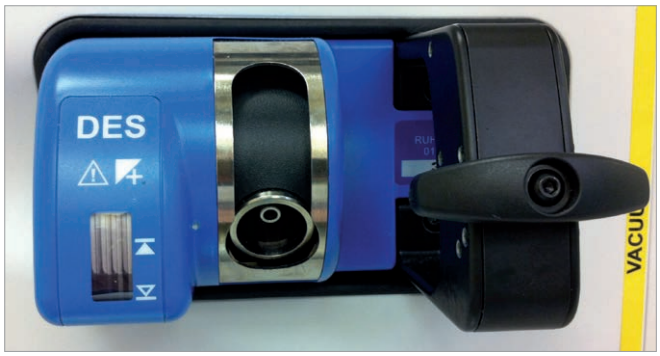
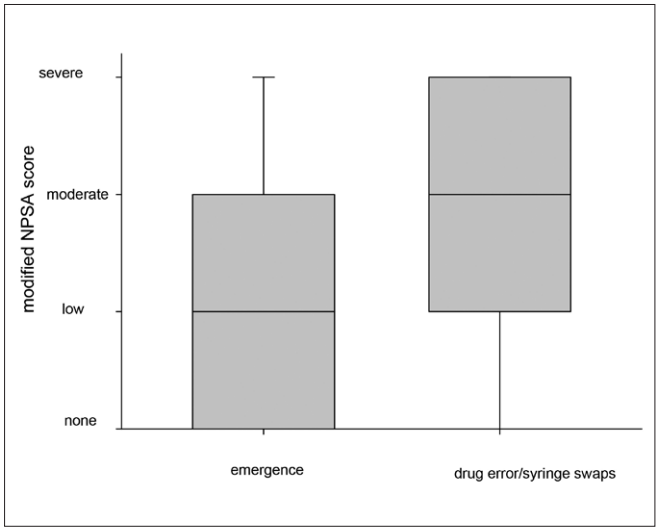


Figure 10.1. Boxplot of modified NPSA score for cases at emergence and for syringe swaps/drug errors (see Chapter 13). Note that the whereas the median impact for emergence cases is 'low' with 'severe' being rare, the median for drug errors is 'moderate' with 'none' being uncommon



10.24 The Panel considered that the current management of neuromuscular blockade by the anaesthetic community (as reflected by the Activity Survey and in these reports) was surprising and indeed fell short of best practice. Neuromuscular blockade is required to facilitate certain types of surgery (e.g. abdominal, cardiac, thoracic, etc) and perhaps a case can be made for its use in certain patient groups (e.g. to facilitate controlled ventilation in the obese or those with impaired lung function or difficult airways). The effect of all drugs should ideally be monitored: thus, end-tidal monitoring is used for volatile agents, blood pressure for vasoactive agents, etc. For neuromuscular block, the only appropriate monitor is the nerve stimulator. So it is surprising that in the Activity Survey, a nerve stimulator was employed in a minority (38%) of cases where nondepolarising block was used.

10.25 Current AAGBI guidelines (AAGBI, 2007) specify that a nerve stimulator should be available for use. However, they do not specify that it should *always* be used whenever nondepolarising blockade is employed. This is in striking contrast to recommendations concerning the end-tidal monitoring of volatile agent.

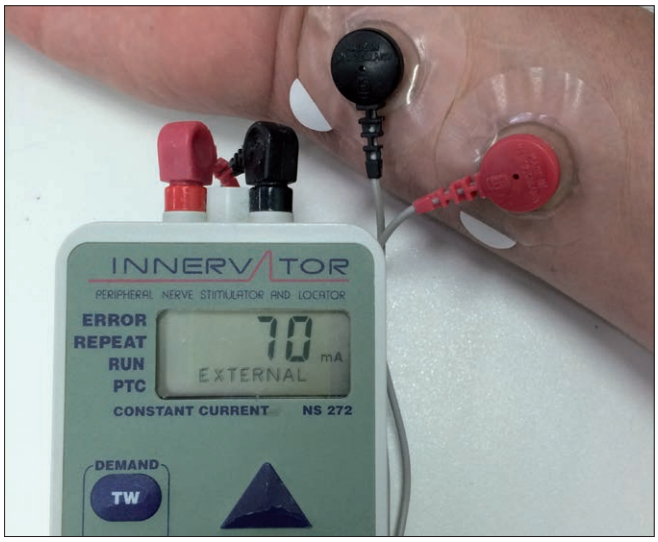
10.26 It is possible that anaesthetists generally feel that during surgery, the measure of drug effect that matters is the response of the surgical team to the degree of muscle relaxation (i.e. objective measures provided by a nerve stimulator are relatively unimportant). A common experience is that despite apparently adequate blockade as measured by the nerve stimulator, the surgical team finds the patient 'tight' or breathing, or *vice versa*. This lack of apparent correlation between subjective (team) feedback and objective measurement can undermine faith in the use of a nerve stimulator. Some anaesthetists might reasonably argue that they provide good conditions for surgery without ever using such monitoring.

10.27 However, based on our results, it seems at least as relevant that a nerve stimulator should be regarded as a monitor of 'motor capacity'. When reduced, the 'train of four' (or another suitable index) signifies obtunded *motor capacity*, which leads to distress in an awake patient. A full return of neuromuscular function as assessed by nerve stimulation is a *necessary* (i.e. minimum), but not *sufficient* condition for motor capacity. A patient in whom it has only just returned may still feel partially paralysed, or weak and lack full muscle strength, and therefore be distressed. Understanding the term *motor capacity*, is helpful in understanding the proper role of the nerve stimulator in anaesthetic practice.

10.28 Even a single dose of a neuromuscular blocking drug can lead to residual paralysis (Debaene et al., 2003). Failure to reverse neuromuscular blockade adequately will predictably result in residual paralysis. Baillard et al. (2000), Murphy et al. (2008) and Di Marco et al. (2010) have all shown residual paralysis is commonplace and often goes undetected. Residual paralysis is an under-appreciated problem after anaesthesia, and best practice revolves around coupling information from a nerve stimulator (e.g. train of four ratio >0.9) with use of reversal agent (neostigmine or sugammadex). Baillard et al. (2005) showed that a programme of education could reduce residual curarisation from 62% to 3.5%.

10.29 The possibility that residual paralysis and AAGA were present does not seem to have been foremost in the minds of those managing patients in these reports. The details of some reports suggested that every other avenue was explored before the presence of persistent neuromuscular blockade was considered.

Failure to monitor return of neuromuscular function (as a measure of motor capacity) was a contributory factor in half of cases of AAGA at emergence and all were judged preventable



10.30 Anaesthetic agents in common use, especially sevoflurane, desflurane and propofol, have rapid offset times. Reversing neuromuscular blockade only after cessation of anaesthetic delivery runs a risk of unintentional awake paralysis. It would seem prudent that anaesthetic delivery is stopped only after recovery from neuromuscular blockade is confirmed (i.e. a train of four ratio of >0.9) and when it is certain consciousness will not return before surgery finishes.

10.31 Muscle groups recover from neuromuscular blockade at different rates, and spontaneous ventilation should not be relied on alone as an indicator of full recovery from neuromuscular blockade and hence *motor capacity*.

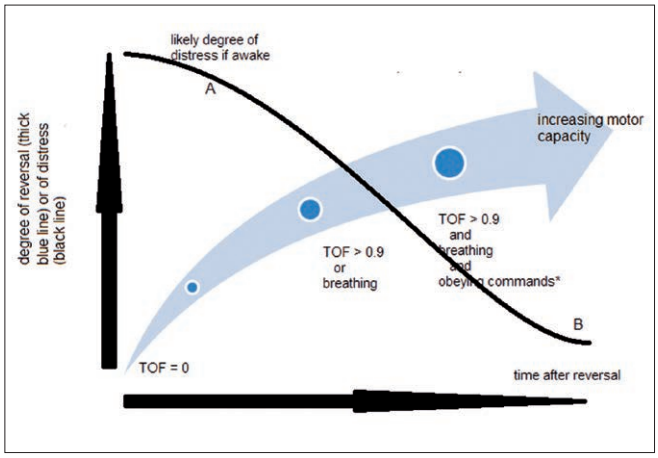
10.32 Neuromuscular blockade impairs *motor capacity* directly and general anaesthesia by contrast impairs *mental capacity*, with voluntary motor function (a desire to move) reduced only as a consequence. To avoid adverse symptoms, the first should be restored before the second. What is unknown is the degree of neuromuscular block that reliably allows voluntary movement. Ali et al. (1975) suggested that respiratory function in awake but partially paralysed volunteers was possible, albeit obtunded, even at TOF ratios ~0.6.

10.33 There were several reports which suggested that it had been recognised that residual paralysis and awareness were likely. However, no reports described actions to alleviate the distress caused during this phase of anaesthesia. Equally surprising was that

sugammadex was not recorded as being used in those situations where it might have been indicated.

10.34 Figure 10.2 illustrates the points made above, reinforcing the need to restore motor capacity and mental capacity in an appropriate order and the adverse effects of not doing so.

Figure 10.2 Illustratration of the relationship between the degree of reversal of neuromuscular blockade (y-axis) versus the signs of reversal (thick blue line), as a function of time after reversal. Also shown is the likely degree of distress (black line), if anaesthesia has been ceased. TOF = train of four ratio. At point A, soon after administering reversal, there is little motor capacity and therefore, a high degree of likely distress if the patient is awake. At point B, there is considerably higher motor capacity and low degree of distress if the patient is awake



10.35 The Panel noted a need for better communication between anaesthetist and surgeon at critical points in surgical procedures. The recommended 'ABCDE' anaesthetic checklist (see Chapter 8, Induction) before the start of surgery is a potentially useful signal to the surgical team that the patient is ready for surgery. It is also useful for surgeons to communicate when they are coming to the end of surgery, to enable the anaesthetists to prepare for emergence. A clear statement from the surgeon that the 'operation is over' (when all interventional contact with the patient has ceased, and not before) could be used as a formal cue to permit emergence from anaesthesia.

10.36 The notion of 'awake tracheal extubation' warrants some discussion. The majority of cases of AAGA at emergence occurred during 'awake extubation'. The rationale for awake extubation being a safe method relies on the idea that awake, co-operative patients are able to maintain their own upper airway and breathe well, such that when extubated there is unlikely to be respiratory difficulty. However, this rationale relies upon there being adequate recovery from/reversal of neuromuscular blockade, and in the cases reported here this was not the case.

10.37 Patients who reported AAGA during emergence rarely mentioned feeling the tracheal tube per se, but rather they experienced distressing paralysis. This cohort of patients therefore mainly consists of patients in whom awake extubation was attempted before they had fully recovered from neuromuscular blockade. The DAS Extubation Guidelines are completely clear that full neuromuscular recovery is an absolute prerequisite for attempted awake extubation; being actually 'awake' is only a secondary requirement. Furthermore, these Guidelines stress the need for the patient to obey motor commands (which are normally commands to squeeze fingers and open the mouth, etc). It is difficult to imagine how, in these reports where patients felt paralysed after 'awake extubation', these steps had been carefully followed. Perhaps these NAP5 results indicate that some anaesthetists may have placed erroneous emphasis on the patient simply being 'awake', rather than being fully recovered from neuromuscular blockade.

10.38 In the Activity Survey, ~1.8 million patients were estimated to undergo airway removal awake after general anaesthesia (~820,000 after neuromuscular blockade). Yet, only 26 patients in NAP5 reported the experience as AAGA (1:69,200 or 1:35,000 respectively). This underlines the fact that airway removal *per se* is not an unpleasant experience and that the main reason for distress is continued paralysis.

10.39 Regardless of the details of anaesthetic practice involved, the relatively high proportion of NAP5 cases associated with emergence implies that patient expectations had not been optimally managed. Hence, the process of consent should acknowledge that this phase of anaesthesia (like the dynamic phase of induction) is a time of relatively high risk of AAGA.

IMPLICATIONS FOR RESEARCH

Research Implication 10.1
There is a need for research into optimal methods of communication between anaesthetic and surgical teams, to signal critical time points during surgery.

Research Implication 10.2
Further research is needed on how the depth of neuromuscular blockade assessed objectively correlates with the ability to respond voluntarily (e.g. do patients feel they can move, if they need to, at a train-of-four ratio ~0.5, etc). Similarly, it may be important to examine why some patients feel distressed when paralysed but others appear not to.

Research Implication 10.3
Research or consensus should establish a recommendation for the optimum role for sugammadex in the treatment of residual paralysis, compared with conventional reversal agents.

RECOMMENDATIONS

RECOMMENDATION 10.1
Anaesthetists should recognise that residual paralysis at emergence is interpreted by patients as AAGA. When recognised, it should be managed using the same Recommendations in this Report as apply to AAGA arising in other phases of anaesthesia, with the same level of psychological support.

RECOMMENDATION 10.2
When planning an awake extubation, this should be explained to the patient as part of the consent process, including the possibility of recall of the tube in the airway or difficulty in moving or breathing at this time.

RECOMMENDATION 10.3
In addition to communication throughout surgery, there should be formal confirmation from the surgeon to the anaesthetist and other theatre staff that surgery has finished. This point should be at the actual completion of all interventional procedures (including dressings, post-surgical examinations, etc) and could be usefully linked to the sign-out section of the WHO checklist.

RECOMMENDATION 10.4
The nerve stimulator should be used to establish motor capacity. An adequate response to nerve stimulation (e.g. return of a 'train of four' ratio of >0.9, or other suitable measure) is a minimum criterion of motor capacity. Following this assessment, anaesthetists should use additional signs such as spontaneous breathing and motor response to command before full motor capacity is judged restored.

RECOMMENDATION 10.5
The relevant anaesthetic organisations should consider including nerve stimulators as 'essential' in monitoring guidelines, whenever neuromuscular blocking drugs are used.

RECOMMENDATION 10.6
All patients who have less than full motor capacity as a result of pharmacological neuromuscular blockade should remain anaesthetised.

RECOMMENDATION 10.7
Anaesthetists should regard an 'awake extubation' (as stressed in DAS Extubation Guidelines) as an undertaking in a patient who primarily has full motor capacity, and secondarily is co-operative to command. Being 'awake' alone does not fulfil any safe conditions for tracheal extubation.

RECOMMENDATION 10.8
The possibility of pseudocholinesterase deficiency should be considered whenever using mivacurium or suxamethonium. Where suspected, anaesthesia should be maintained until full recovery from neuromuscular blockade is confirmed. Genetic testing should be arranged.

RECOMMENDATION 10.9
During emergence, speaking to patients to explain what is happening provides important reassurance about potentially unusual sensations such as tracheal intubation or partial paralysis.

REFERENCES

Association of Anaesthetists of Great Britain and Ireland. *Recommendations for Standards of Monitoring during Anaesthesia and Recovery.* 4th edition. AAGBI: London, 2007.

Ali HH, Wilson RS, Savarese JJ, Kitz RJ: The effect of tubocurarine on indirectly elicited train-of-four muscle response and respiratory measurements in humans. *British Journal of Anaesthesia* 1975;**47**:570–74.

Atkinson RS, Rushman GB, Lee JA. *A Synopsis of Anaesthesia*, 9th edn. Bristol: John Wright & Sons Ltd, 1982.

Baillard C, Gehan G, Reboul-Marty J, Larmignat P, Samama CM, Cupa M. Residual curarization in the recovery room after vecuronium. *British Journal of Anaesthesia* 2000;**84**:394–95.

Baillard C, Clec'h C, Catineau J, Salhi F, Gehan G, Cupa M, Samama C.M. Postoperative residual neuromuscular block: a survey of management. *British Journal of Anaesthesia* 2005;**95**:622–26.

Bourne JA. Thiopentone-nitrous-oxide–oxygen anaesthesia with curare for head and neck surgery. *British Medical Journal* 1947;**2**:654–55.

Debaene B, Plaud B, Dilly MP, Donati F. Residual paralysis in the PACU after a single intubating dose of nondepolarizing muscle relaxant with an intermediate duration of action. *Anesthesiology* 2003;**98**:1042–48.

Di Marco P, Della Rocca G, Iannuccelli F, Pompei L, Reale C, Pietropaoli P. Knowledge of residual curarization: an Italian survey. *Acta Anaesthesiologica Scandinavica* 2010; **54**:307–12.

Gornall BF, Myles PS, Smith CL, et al. Measurement of quality of recovery using the QoR-40: a quantitative systematic review. *British Journal of Anaesthesia* 2013;**111**:161–69.

Faleiro CF, Sinclair RJ. Delayed recovery of consciousness after anaesthesia *Continuing Education in Anaesthesia, Critical Care & Pain* 2006;**6**:114–18.

Gillies M.A.M, Baldwin FJ. Do patient information booklets increase perioperative anxiety? *European Journal of Anaesthesiology* 2001;**18**:620–22.

Leavitt, HJ. Some effects of certain communication patterns on group performance. *The Journal of Abnormal & Social Psychology* 1951;**46**:38–50.

Murphy GS, Szokol JW, Marymont JH, Greenberg SB, Avram MJ, Vender JS. Residual neuromuscular blockade and critical respiratory events in the postanesthesia care unit. *Anesthesia & Analgesia* 2008;**107**:130–37.

Myles PS, Reeves MD, Anderson H, Weeks AM. Measurement of quality of recovery in 5672 patients after anaesthesia and surgery. *Anaesthesia & Intensive Care* 2000;**28**:276–80.

Oldman M, Moore D, Collins S. Drug patient information leaflets in anaesthesia: effect on anxiety and patient satisfaction. Appendix A. *British Journal of Anaesthesia* 2004;**92**:854–58.

Popat M, Mitchell V, Dravid R, Patel A, Swampillai C, Higgs A. Difficult Airway Society Guidelines for the management of tracheal extubation. *Anaesthesia* 2012; **67**:318–40.

Wylie W.D, Churchill-Davidson HC. *A Practice of Anaesthesia*, 3rd edn. London: Lloyd-Luke, 1972.