

The state of UK anaesthesia for the obese; results of a survey of National Health Service activity and comparison with current recommendations.

A national survey by the 5th National Audit Project of the Royal College of Anaesthetists and the Association of Anaesthetists of Great Britain and Ireland

J.H.MacG. Palmer,¹ C.E. Nightingale,² M.R.J. Sury,³ J.J Pandit⁴ and T.Cook⁵ and the rest of the NAP5 group

1. *Consultant Anaesthetist, Salford Royal Hospital NHS Foundation Trust, Salford, UK*
2. *Consultant Anaesthetist, Buckinghamshire Healthcare NHS Trust, Amersham, UK*
3. *Consultant Anaesthetist, Great Ormond Street Hospital NHS Foundation Trust, London, UK & Honorary Senior Lecturer, Portex Unit of Anaesthesia, Institute of Child Health, University College London, UK*

Correspondence to:

Dr James Palmer, Dept of Anaesthesia, Salford Royal NHS Foundation Trust,

Stott Lane, Salford M6 8HD Tel. 0161 2065107 email: james.palmer@srft.nhs.uk

Running title: UK anaesthesia for the obese

Summary

We performed further analysis of the 2013 United Kingdom National Health Service (NHS) Anaesthesia Activity Survey of the Fifth National Audit Project of the Royal College of Anaesthetists and Association of Anaesthetists of Great Britain and Ireland (AAS). We examined data from adult obese patients in detail and compared practice in 2013 (published in 2014) with the Guidelines on perioperative management of the obese surgical patient published in 2015 by the Association of Anaesthetists of Great Britain and Ireland and the Society for Obesity and Bariatric Anaesthesia. Of the main recommendations, seven could be directly assessed by the AAS. We found that some recommendations were already standard practice (recording of BMI, use of regional anaesthetic techniques wherever possible, use of tracheal intubation), but others were not in common use in 2013 (in-theatre induction, avoidance of sedation and monitoring of neuromuscular blockade). There appears to be some way to go if UK anaesthesia is to adopt the recommendations fully.

Introduction

The last two national audits into anaesthetic complications have highlighted obesity as a risk factor for airway problems and accidental awareness under anaesthesia [1, 2]. The Association of Anaesthetists of Great Britain and Ireland and the Society for Obesity and Bariatric Anaesthesia published guidelines recently on the perioperative management of the obese surgical patient [3] which contained not only a summary of pathophysiology, pharmacology, preoperative assessment, anaesthetic conduct and postoperative care, but also 16 direct recommendations in relation to anaesthetic techniques and management. These recommendations were based on published evidence and provide a strategic aim for UK anaesthesia practice. We have examined anaesthesia activity data in detail from adult obese patients and determined how closely practice in 2013 anticipated the recommendations.

Methods

In 2013, as part of the Fifth National Audit Project (NAP5) of the Royal College of Anaesthetists and Association of Anaesthetists of Great Britain and Ireland [REF], an Anaesthesia Activity Survey (AAS) was carried out to measure annual caseload of peri-procedural anaesthetic activity in the United Kingdom National Health Service (NHS)[4]. The full method for the AAS is published elsewhere [4], but in summary, each NHS hospital, Trust and Board in the UK was represented by a local coordinator (LC). LCs coordinated the survey in their own hospital or group on any NHS patient who had any procedure under the care of an anaesthetist: this included general anaesthesia (GA), sedation, or the monitored anaesthesia care of an awake patient.

Data collection for a whole week was deemed both too costly and taxing therefore each LC was randomised to two consecutive days within the chosen week (9th to 16th September 2013). A scaling factor (180.68) converted the number of forms returned from two days into an estimated number of cases for a whole year (i.e. annual caseload)-[4]. Caseloads were rounded to the nearest 100, so that an estimated annual number of 200 or 400 represent 1 or 2 forms respectively.

Data were captured on a single sided A4 paper questionnaire and read automatically by 'optical character recognition' technology (DRS Data & Research Services plc., Milton Keynes, Buckinghamshire, UK). The form had 30 questions (REF) and explanatory notes to help completion. Calculations were made using Microsoft Excel 2010® and the 'PivotTable' facility. Blank, uninterpretable and missing answers were discarded; thus analysis and results relate only to interpretable forms.

The BMI classes on the AAS form were: underweight (BMI<18.5), normal weight (BMI 18.5-24.9), overweight (BMI 25-29.9), obese (BMI 30-34.9), morbidly obese (BMI ≥35)¹ and Unknown. For purposes of comparison, data from obese and morbidly obese patients (i.e. all those with BMI ≥ 30) were combined and

¹ The World Health Organisation currently uses different nomenclature for BMI ≥ 35 as follows: BMI ≥35 to 40 = severe obesity, ≥40 to 45 = morbid obesity and ≥45 to 50 = super obesity. In this report, morbid obesity = BMI≥35.

compared with data from 'non-obese' (BMI <30) patients or with data from patients with normal BMI (underweight and overweight patients excluded). Children (<16y) and obstetric patients were excluded from the data analysis (obstetric patients were identified from caesarean section categories as well as the 'obstetric' surgical specialty).

General characteristics of activity in obese and morbidly obese patients were described and, where possible, we have used the activity data to assess how often activity in 2013 matched the recommendations of the working party (Table 1). Some recommendations could be examined directly: for example, the location of induction of anaesthesia. Some recommendations were assessed indirectly using surrogate markers (e.g. using day surgery categorization to estimate rate of early mobilization).

Results

Of the annual caseload of 3,154,130 adults, 2,546,500 were classified as 'not obstetric'. In this population 96.6% had BMI recorded of whom 1,216,900 (47.8%) had normal BMI and 571,000 (22.4%) had a BMI ≥ 30 (15.1% were obese and 7.3% were morbidly obese).

Ethnicity, Age, Sex and ASA

Ethnicity was recorded by the AAS in over 99% of patients. The ethnic groups with highest rates of obesity (BMI>30) were Black or Afro-Caribbean 23.75, and White Caucasian (22.7%) . The BMI of other patients who identified themselves with a specific ethnicity comprised Asian/British Asian/Indian (19%), Mixed (18.64%), and Chinese/Japanese/SE Asian (12%) although numbers of this last group were small (11,000). A large group of patients who identified themselves as ethnically 'other' than the standard groupings contained a large proportion (22%) of high BMI patients. Figure 1 shows the percentage of patients with BMI ≥ 30 (obese and morbidly obese) within each age group. In each of the age groups 46-55y, 56-65y and 66-75y there were more than 100,000 patients with BMI ≥ 30 . Of all patients with BMI ≥ 30 , 77% cent were aged 36 to 75y and 61%

were female. ASA grade did not appear to be related to BMI: 3.5% of patients with BMI ≥ 30 and 3% of normal BMI patients were ASA4 or 5.

General management

In all BMI groups the most common operations performed were orthopaedics & trauma, general surgery, gynaecology, urology and ENT (Figure 2).

Proportionally, however, more patients with BMI ≥ 30 underwent orthopaedics and trauma procedures than non-obese patients. A substantial proportion (46%) of patients with BMI ≥ 30 had procedures managed as day cases although this was lower than normal BMI patients (51.5%). Anaesthesia management in BMI ≥ 30 patients was delivered by a consultant in 76% and by a junior trainee grade (ST3 or CT) in 1.6% (compared with 2.7% of normal BMI patients; Table 2). The location of induction of general anaesthesia was not related to BMI: anaesthesia was induced in the operating theatre rather than an anaesthetic room in 17% of patients with BMI ≥ 30 compared with 19% of patients with normal BMI.

Intended conscious level and local anaesthetic techniques

The percentage of patients managed awake or with sedation was not appreciably different between the BMI categories (Figure 3). In respect of the most common operations (orthopaedics & trauma, general surgery, gynaecology and urology), the proportion of obese or morbidly obese patients having any kind of neuraxial block was 15% compared with 10% of non-obese patients. Of patients receiving any kind of neuraxial block more patients with BMI ≥ 30 were managed with sedation than normal BMI patients although nearly 50% received general anaesthesia (Table 3).

Urgency and time of day

As BMI increased the proportion of patients within each BMI class undergoing emergency anaesthesia decreased: the percentage of BMI ≥ 35 patients undergoing immediate or urgent procedures was lower than any other BMI class (Figure 4). The annual caseload of morbidly obese patients (BMI ≥ 35) undergoing urgent procedures was 24,900 (Table 4) and of these 32% were general surgery and 32% were orthopaedics and trauma procedures. The time of

start of induction was not related to BMI class: there were, overall, 35,000 patients induced between midnight and 0800 but of these only 9,300 were BMI ≥ 30 patients and for almost all of these (excepting one returned questionnaire) the anaesthetist was more senior than a ST3 grade.

Rapid sequence induction, neuromuscular blockade, monitoring and reversal

Rapid sequence induction (RSI) was used in 6% of obese and 9% of morbidly obese patients (Figure 5): most of these patients had propofol (69% & 80% respectively) and an opioid (76% & 86% respectively). Approximately 60% of RSI patients received suxamethonium in any BMI group.

Neuromuscular blockade (NMB) was used most frequently in morbidly obese patients, nevertheless 56% of obese and 46% of morbidly obese patients were anaesthetised without any NMB. Neuromuscular monitoring was used more frequently as BMI increased, yet only 57% of obese and 51% of morbidly obese patients (given a NMB) were monitored with a nerve stimulator. NMB was not reversed in 30% of obese and 24% of morbidly obese patients. Sugammadex was used in 1.5% of normal BMI, 2.1% in obese and 2.9% of morbidly obese patients who received a non-depolarising NMB.

Maintenance agent and depth of anaesthesia monitoring

Desflurane was the maintenance agent for 24% of morbidly obesity patients compared with 14% to 17% in the other BMI groups. Nitrous oxide was used in less than 25% of patients with no difference between BMI classes. Remifentanyl was used in 14.5% of patients with BMI ≥ 30 compared with 11.8% of normal BMI patients.

Target controlled infusion (TCI) of propofol was used least (4.8%) in morbidly patients. Depth of anaesthesia monitoring was infrequent in any BMI class (less than 3.5%): in patients anaesthetised with a propofol infusion technique, 21% with BMI ≥ 30 were monitored compared with 15% of normal BMI patients.

Airway management

Excluding underweight patients the proportion of patient managed with a tracheal tube increased as BMI increased (Figure 6). Less than 3% of obese or morbidly obese patients were managed without a supraglottic airway (SAD) or tracheal tube. Tracheal tubes were removed awake in 82% of normal BMI and 88% of BMI ≥ 30 intubated patients.

Return of consciousness

Eight deaths were reported in patients with BMI recorded: 2 had normal BMI (0.04%), 2 were overweight ((0.06%) and 4 were obese patients (0.24%); causes of death were not recorded. Except for underweight patients, as BMI increased the proportion of patients recovering consciousness in the operating theatre increased (Figure 7): 50% of patients with BMI >35 awoke in theatre.

Discussion

There are several uncertainties about the AAS data that may affect the accuracy of any conclusions. The BMI categories on the AAS form did not exactly match the current WHO classification of obesity and we have therefore referred to BMI rather than class to avoid confusion. The AAS figure of 22% with a BMI>30 is lower than 26% quoted by the Office of National statistics in 2012, suggesting that either fewer obese people attend hospital or, more likely, that there is a tendency to underestimate patients' weight (or use out of date information). The reader may well ask why obstetric patients were excluded from this data analysis. Although included in the AAS, we excluded obstetric patients because many of the obesity guidelines have been adapted from obstetric anaesthetic practice (the predominance of regional anaesthesia, in theatre induction, use of tracheal tubes and in-theatre emergence) and would make interpretation less meaningful. The AAS results state that BMI was recorded on more than 96% of occasions but it is possible that this was the best estimate of the anaesthetist completing the AAS and that BMI was neither accurately recorded in the patient's record nor on the operating list (see recommendation 2). Knowing the weight and the BMI prior to surgery should guide decision making about not only anaesthesia, but the whole of intraoperative care.

Some of the findings of this analysis will be unsurprising to anyone working in the health service. The preponderance of female and both white Caucasian and black or Afro-Caribbean patients in the higher BMI range and the 'middle aged spread' of high BMI patients between the ages of 46 and 65 years are public knowledge [Ref]. It is encouraging that some UK anaesthetists had already adopted a number of the nascent recommendations of SOBA and the AAGBI by 2013 (when the AAS took place) but there is little evidence of widespread practice congruent with them. This suggests that in 2013 there was a certain number of 'early adopters' and a larger body who needed the information provided by the guidelines from SOBA and the AAGBI as a stimulus to change practice.

The high percentage of anaesthesia delivered by consultants or career doctors reflects the continued change in UK practice towards a consultant delivered

service, but there are still some patients with a BMI >35 being managed solely by junior medical staff.

Induction in theatre rather than in an anaesthetic room not only reduces the chance of awareness or atelectasis and subsequent arterial desaturation, but also reduces the amount of handling and the risk of injury to staff or patient; in 2013 there was no evidence of this practice being specifically applied to obese patients.

Regional anaesthesia offers many advantages in the obese- especially those with undiagnosed sleep disordered breathing where general anaesthesia and sedation increase the risk of postoperative problems. There is evidence from the data that neuraxial block is more widely used in the obese, (15% v 10%) but disappointingly, there is no appreciable difference in the number of patients managed without sedation. Indeed, there is suggestion from the results that deeper sedation is being administered to heavier patients; a less than ideal situation.

Due to the increased work of breathing and concomitant increase in oxygen requirement, it is recommended that the lungs of the obese are ventilated during anaesthesia. This is easiest with neuromuscular blockade (NMB) and a tracheal tube. The AAS shows this was not current in 2013; 56% of BMI 30 and 46% of BMI >35 patients were anaesthetised without NMB and only 51% of BMI 30 and 64% of BMI >35 being managed with a tracheal tube. Worryingly, and much as found in other patient groups, neuromuscular blockade was not reversed and less than half of those given NMB were monitored with a nerve stimulator. The increased use of sugammadex in high BMI patients either reflects recognition of inadequate NMB reversal with neostigmine, or the planned use of Sugammadex with the aim of providing optimum motor capacity to facilitate uncomplicated recovery. Unfortunately the AAS did not have the level of detail to assess either adequacy of dosing using conventional agents (neostigmine) or whether both neostigmine and sugammadex were used. The use of awake extubation in the vast majority of obese patients (88%) is a welcome testimony to the general understanding of the risks the obese are exposed to on emergence. However, 6.2% of Patients with a BMI >35 have their tracheal tube removed when they are

still asleep. (These were a mixture of ENT, gynaecology and general surgical cases).

It is encouraging to see preferential use of Desflurane in the obese suggesting a good understanding of the favourable pharmacokinetics and recovery characteristics of this drug. However, target controlled propofol infusions (TCI) were rarely used, particularly for the heaviest patients. This may reflect anaesthetists' technique of choice, a lack of confidence in the algorithms with larger patients, or unavailability of algorithms tailored to the obese (e.g. the Eleveld algorithm [Ref.]). On a similar theme, DOA monitors are useful in the obese, not only to prevent awareness but also to allow titration of anaesthetic to shorten emergence and accelerate return of respiratory function. Only 3% of patients were monitored in this way, use increasing very slightly with increasing patients' weight and use with TIVA was marginally more than in patients of normal weight. This falls short of the recommendation to use DOA in all cases where TIVA is used.

Oddly, obese patients were less likely to be classified as urgent or expedited. This is hard to interpret, either indicating that either they are less sick, which is unlikely, or that there is a failure to recognise how sick they are (the only sign of an acute abdomen in the obese patient may be a tachycardia). Additionally difficulties in examination and imaging may delay diagnosis.

The relatively large numbers of patients having day case procedures is commendable; an area of anaesthesia that is often challenging in this patient group and one where the patient benefits are significant, not least in early resumption of mobility and reduction in VTE.

A further national survey of anaesthetic activity would obviously answer questions about how much has changed since 2013.

References

1. NAP3
2. NAP4

3. Guidelines recently on the perioperative management of the obese surgical patient
- 4.

Tables

Table 1: Recommendations concerning anaesthesia for obese patients

Abridged recommendations of a working party of the Association of Anaesthetists of Great Britain and Ireland and the Society for Obesity and Bariatric Anaesthesia [3]. Underlined recommendations are those that can be assessed using the UK Anaesthesia activity data.

1 Every hospital should nominate an anaesthetic lead for obesity.
2 Operating lists should include the patients' weight and body mass index (BMI).
<u>3 Experienced anaesthetic and surgical staff should manage obese patients.</u>
4 Additional specialised equipment is necessary.
5 Central obesity and metabolic syndrome should be identified as risk factors.
6 Sleep-disordered breathing and its consequences should always be considered in the obese.
<u>7 Anaesthetising the patient in the operating theatre should be considered.</u>
<u>8 Regional anaesthesia is recommended as desirable but is often technically difficult and may be impossible to achieve.</u>
<u>9 A robust airway strategy must be planned and discussed, as desaturation occurs quickly in the obese patient and airway management can be difficult.</u>
10 Use of the ramped or sitting position is recommended as an aid to induction and recovery.
11 Drug dosing should generally be based upon lean body weight and titrated to effect, rather than dosed to total body weight.
12 Caution is required with the use of long-acting opioids and sedatives.
<u>13 Neuromuscular monitoring should always be used whenever neuromuscular blocking drugs are used.</u>
<u>14 Depth of anaesthesia monitoring should be considered, especially when total intravenous anaesthesia is used in conjunction with neuromuscular blocking drugs.</u>
<u>15 Appropriate prophylaxis against venous thromboembolism (VTE) and early mobilisation are recommended.</u>
<u>16 Postoperative intensive care support should be considered.</u>

Table 2: Most senior anaesthetist present

	Normal	Obese	Morbidly obese
Consultant	73.8%	75.9%	76.4%
Non-training grade	15.6%	16.1%	15.8%
ST4-7	7.1%	5.5%	5.8%
ST3 & CTs	2.7%	1.6%	1.6%
Other	0.8%	0.9%	0.4%

Table 3: Level of Consciousness in patients with neuraxial blockade

	Normal	Obese	Morbidly obese
General anaesthesia	52.1%	47.8%	48.8%
Deep sedation	2.2%	4.6%	4.2%
Moderate sedation	8.7%	14.0%	15.0%
Minimal sedation	12.8%	16.1%	13.1%
Awake	24.2%	17.5%	18.8%

Table 4: Annual caseload according to urgency

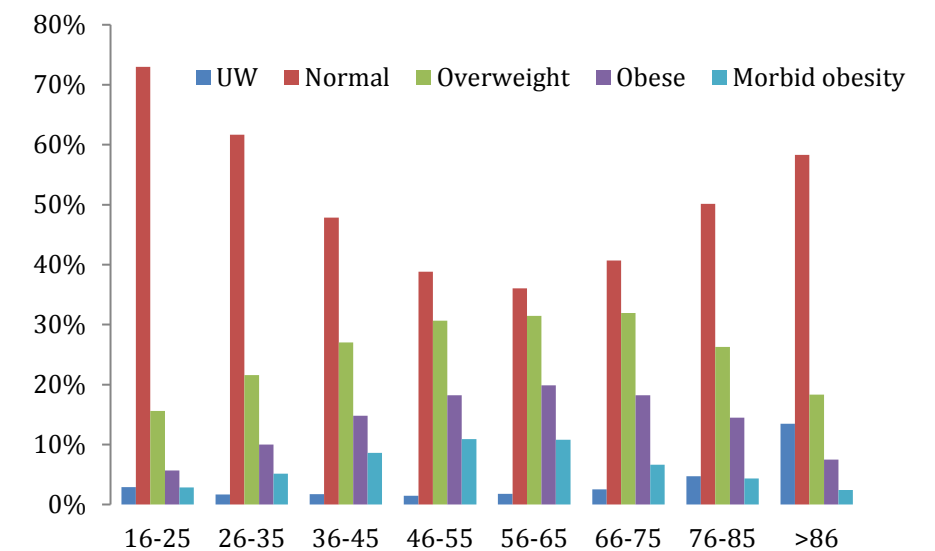
Estimated caseload (*1000)

	Under-weight	Normal	Over-weight	Obese	Morbidly Obese
Immediate	2.7	24.8	13	6.5	2.2
Urgent	22.4	255.8	108.2	60.3	24.9
Expedited	8.3	79.9	45.9	18.1	9.6
Elective	34.7	856.4	523.4	299.4	150
Total	68.1	1217	690.6	384.3	186.6

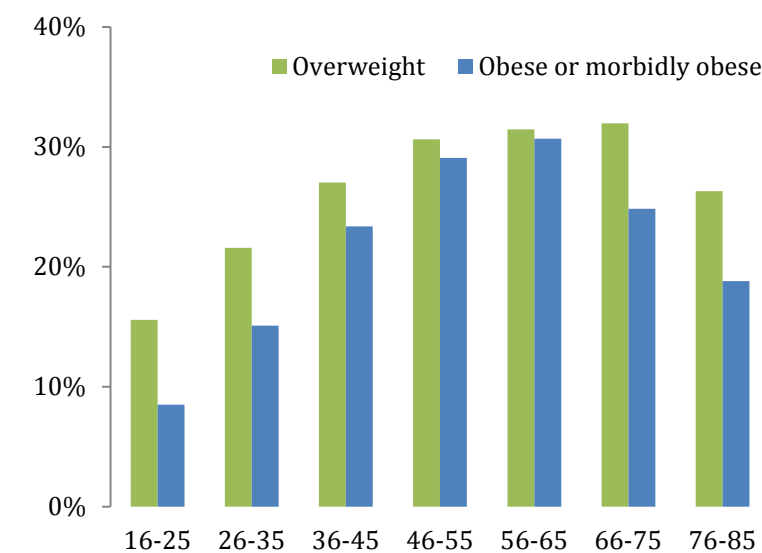
Figures

Figure 1: Distribution of BMI category within age groups

Percentage of patients according to BMI class within each age group.



OR



OR

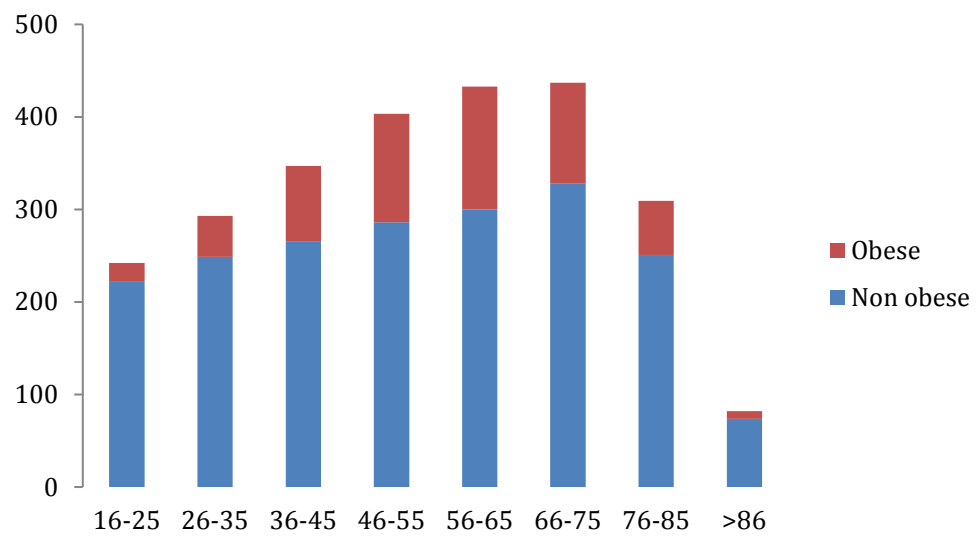


Figure 2: Specialty

Five most common operation types within BMI class

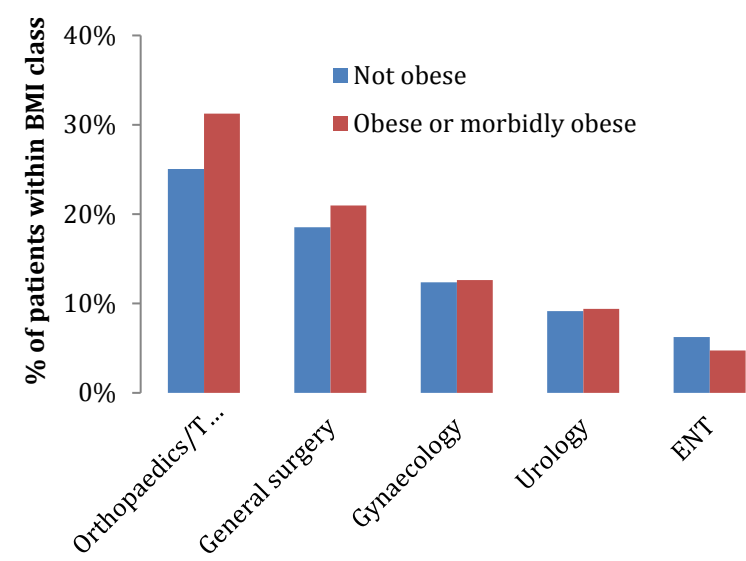
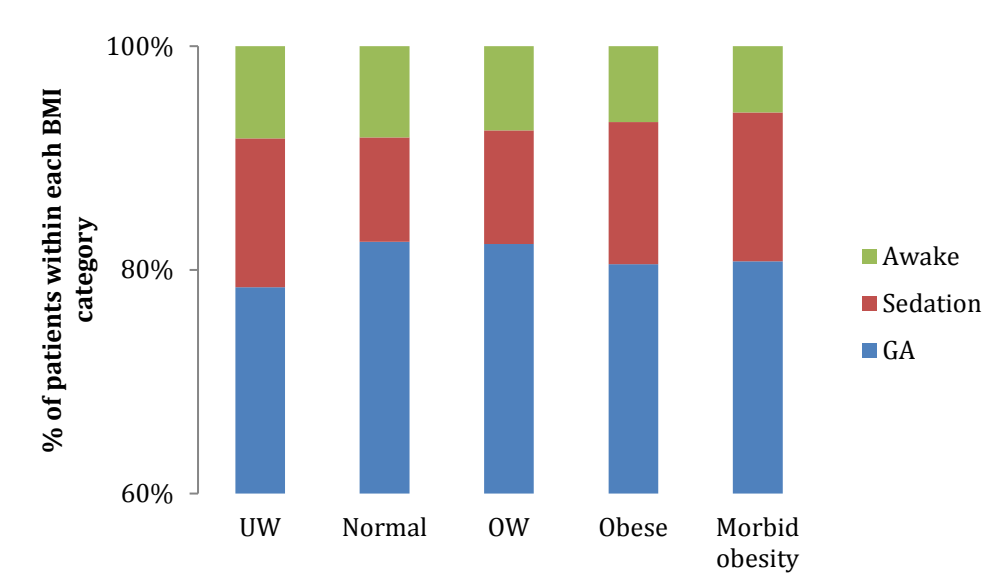


Figure 3: Intended conscious level



OR

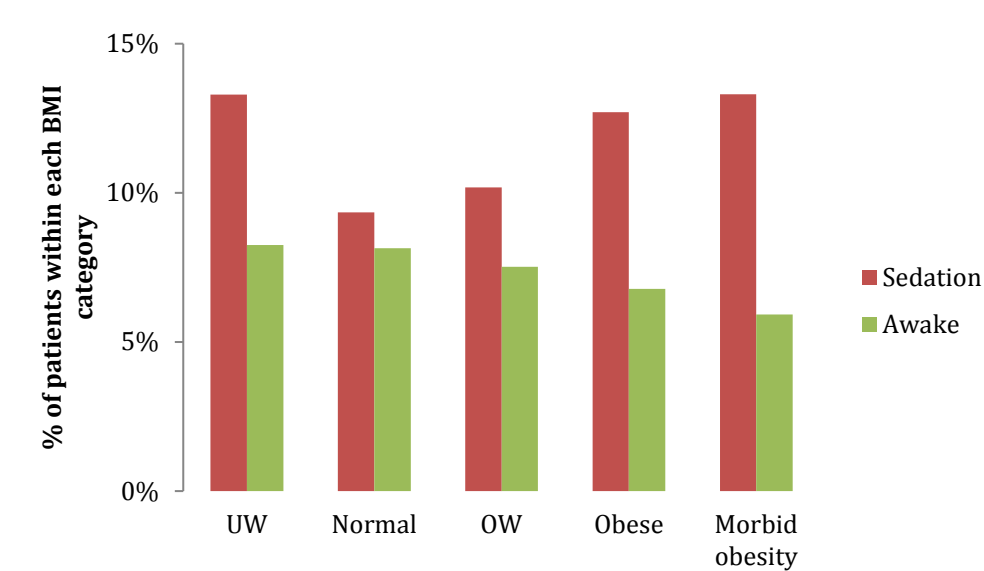


Figure 4: Urgency

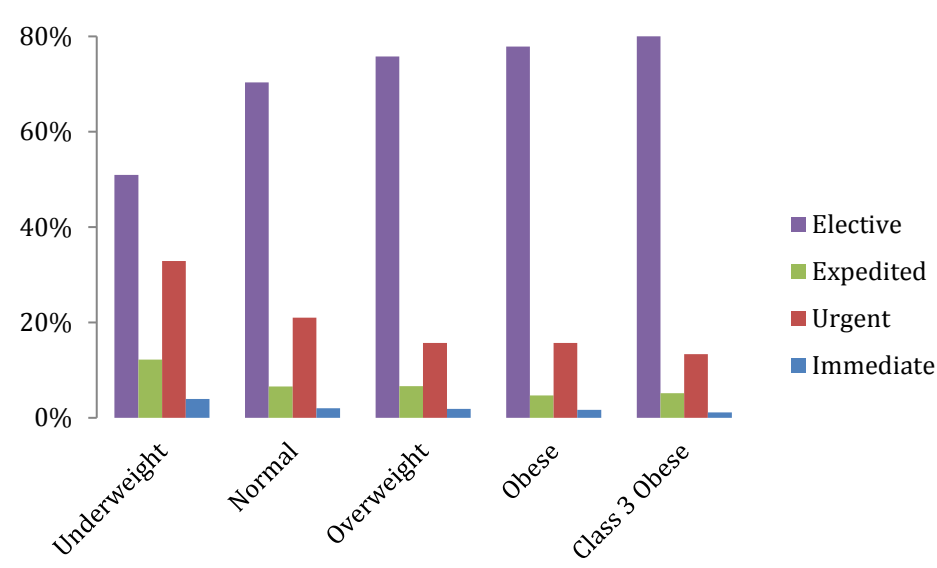
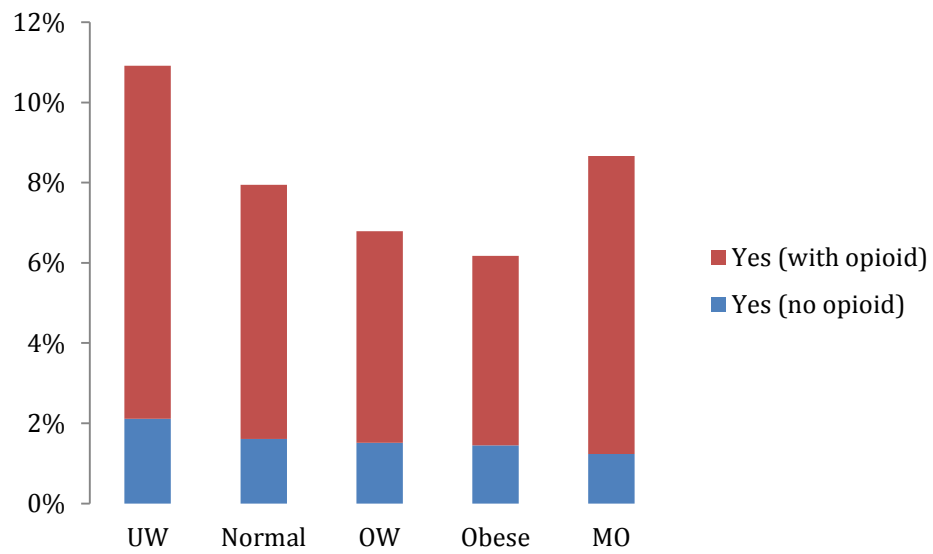


Figure 5: Rapid sequence induction

% = % within each body habitus group



Figured 6: Main airway device

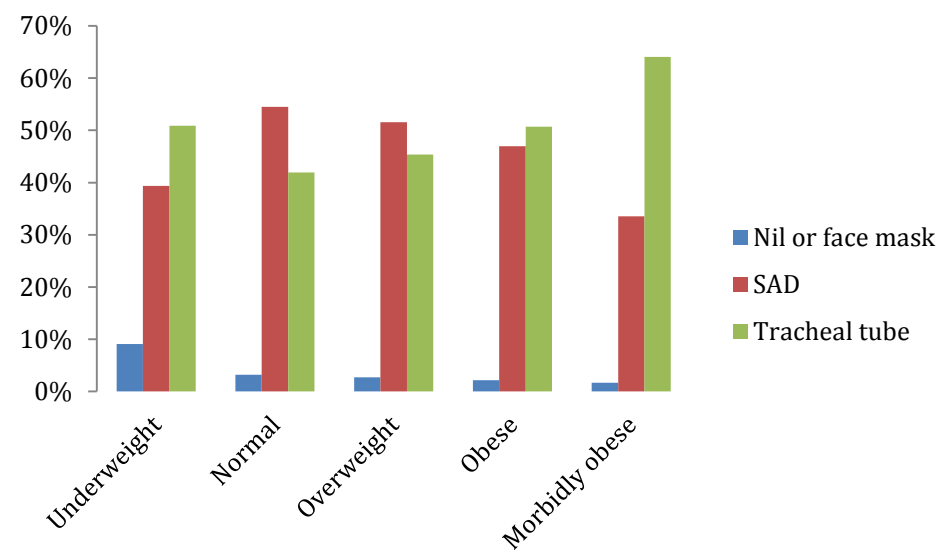


Figure: Location of return of consciousness

