Anaesthetic experience of vertical banded gastroplasty

S. T. Goulding and B. C. Hovell

Summary
We have reviewed data from 200 patients who underwent weight-reducing surgery in a district general hospital. Mean age was 38.5 yr (range 14–60 yr) and mean body mass index (BMI) 45.7 kg m$^{-2}$ (range 30.0–86.8 kg m$^{-2}$). There was one death, which resulted from pulmonary embolus 3 weeks after surgery. Upper abdominal surgery of this type is justified in the morbidly obese and problems were not encountered that would exclude its practice from non-specialized units. (Br. J. Anaesth. 1995; 75: 301–306)

Key words

Obesity is an increasingly common metabolic disease. It affects up to one-third of the population of the United States [1]. Surveys in Western countries suggest that 5% of men and 7.5% of women are severely obese [2, 3]. Body mass index (BMI) is the most useful clinical indicator of obesity (BMI = weight/height$^2$). Obesity is defined as a BMI greater than 30 kg m$^{-2}$ and morbid obesity as a BMI greater than 39 kg m$^{-2}$ [4].

All large prospective studies (number in study greater than 20 000) have found that morbid obesity is associated with an approximately two-fold increase in total mortality and a several-fold increase in mortality from diabetes, cerebrovascular and cardiovascular disease. The incidence of sudden death unexplained at autopsy is up to 40 times greater than in the general population [5].

In the USA up to 40 000 patients a year undergo surgery to control obesity [6], and weight-reducing or bariatric surgery is a surgical subspecialty. Earlier treatment of obesity by bypass surgery was complicated by dumping, vitamin B$_{12}$, folate and iron deficiency [7]. Vertical banded gastroplasty is currently the procedure of choice [8]. However, a questionnaire survey sent to 970 consultant general surgeons working in the UK National Health Service revealed only 38 surgeons actively practising bariatric surgery. Reasons given for not performing or abandoning this type of surgery included fears relating to the problems of jejunoileal bypass, but also prejudices and ignorance about obesity, its causes and therapy, although many treated diseases associated with alcohol and tobacco abuse [9].

A literature search revealed no published anaesthetic experience of bariatric surgery from the UK.

Patients and methods

DATA COLLECTION
Data were acquired by retrospective review of patient hospital records. Records were reviewed of 200 consecutive patients. All records were available over a 5-yr period from 1989 to 1994. Analysis revealed preoperative medical history, including smoking history, anaesthetic technique, postoperative complications and duration of hospital stay.

PREOPERATIVE ASSESSMENT AND CARE
Patients were counselled before operation by a trained nurse, who had herself undergone the operation. The potential risks and benefits of the operation were explained and discussed. At admission a history, clinical examination, full blood count, biochemical profile, chest x-ray and electrocardiogram were undertaken. All patients received s.c. heparin (unfractionated, three times daily, commencing the morning of surgery) and antibiotic prophylaxis (usually a cephalosporin). Patients were seen before and after operation by the physiotherapist.

No patient was refused surgery on anaesthetic grounds. Premedication consisted of a short-acting benzodiazepine, an H$_2$ antagonist and metoclopramide.

GENERAL ANAESTHETIC TECHNIQUE AND INTRAOPERATIVE CARE
Approximately two-thirds of operations and anaesthetics were performed by the same consultant surgeon and consultant anaesthetist. The remaining operations were performed either by a consultant surgeon trained by the consultant surgeon above, or a rotational senior registrar under the direct supervision of one or other of the above. The remaining anaesthetics were performed by a consultant anaesthetist or rotational senior registrar under direct supervision. Specialization of the unit only evolved with increasing experience of the operation.

Anaesthesia was induced on the operating table. Patient monitoring included ECG, pulse oximetry, capnography and arterial pressure recording (with a large width arterial pressure cuff). The use of small i.v. cannulae for induction, with subsequent larger cannulae for i.v. fluids, was used to diminish...
problems of cannulation. After operation, the smaller cannula was dedicated to an opioid infusion or used for patient-controlled analgesia (PCA). Blood transfusion was not required in this series.

A rapid sequence induction with cricoid pressure was performed after careful preoxygenation. There were no failed tracheal intubations and difficult intubation was not greater than expected in the general population. After induction a large gauge nasogastric tube was passed; this was used to empty the stomach and facilitate the surgical technique. It was replaced at the end of the procedure by a standard nasogastric tube. Drugs and dosages used frequently were fentanyl 0.1 mg, thiopentone 500 mg, suxamethonium 100 mg, followed by pancuronium 10 mg. Maintenance comprised nitrous oxide in oxygen and isoflurane. An IDo2 of 0.5 and tidal volume of 1 litre were commonly used. Patients were positioned in the reverse Trendelenburg position and foot rests were required. Peak inflation pressures were not recorded routinely, but peak pressures greater than 30 cm H2O were not reported. Arms were placed on arm rests, thus keeping the weight of the arms off the chest.

Surgical preference was for a vertical incision to reduce operating time, which took 40–60 min. The surgical technique evolved to determine the optimal pouch volume (probably 15–30 ml) and circumference of the outlet stoma (4.75–5.0 cm). Stoma circumference <4.5 cm may result in inadequate weight loss and a high incidence of vertical staple-line dehiscence. A circumference of 5.5 cm is associated with significantly less weight loss and long-term failure [10].

POSTOPERATIVE CARE

After antagonism of neuromuscular block, tracheal tubes were removed when the patient was awake. Patients were then placed semi-recumbent and given oxygen 4 litre min⁻¹ via a face-mask during transfer to a recovery area. Here, additional i.v. analgesia was given before commencement of an opioid infusion. Morphine at a concentration 1 mg ml⁻¹ was used via a syringe driver, typically between 5 and 10 ml h⁻¹. The use of PCA was more frequent towards the end of the study with a 1-mg bolus, 5-min lockout time. The use of PCA was not greater than expected in the general population. After induction a large gauge nasogastric tube was passed; this was used to empty the stomach and facilitate the surgical technique. It was replaced at the end of the procedure by a standard nasogastric tube. Drugs and dosages used frequently were fentanyl 0.1 mg, thiopentone 500 mg, suxamethonium 100 mg, followed by pancuronium 10 mg. Maintenance comprised nitrous oxide in oxygen and isoflurane. An IDo2 of 0.5 and tidal volume of 1 litre were commonly used. Patients were positioned in the reverse Trendelenburg position and foot rests were required. Peak inflation pressures were not recorded routinely, but peak pressures greater than 30 cm H2O were not reported. Arms were placed on arm rests, thus keeping the weight of the arms off the chest.

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Postoperative nursing care included emphasis on oxygen therapy (latterly with the aid of pulse oximetry), physiotherapy and maintaining the semi-recumbent position, or when possible, with the patient sitting in an armchair.

Data were analysed using the computer programme SPSS for Windows version 6.0. Data are recorded as mean (range) and examined using Student’s t test. P < 0.05 was considered significant.

Results

Patient data are presented in table 1. A prospective evaluation of the first 114 patients was made by surgical colleagues. The preoperative mean proportion of excess body weight was 104.1 (sd 34.9) % and median BMI was 44.8 (range 33.2–77.7) kg m⁻². At 1 yr after operation, 54 patients (59 %) had lost more than 50 % excess body weight. No patient lost less than 25 % excess body weight, and the median BMI was 32.5 (21.3–47.8) kg m⁻² [10]. (Ideal weight for height was determined from tables of the Metropolitan Life Insurance Company and body weight was determined as the percentage above ideal weight expressed as a percentage of excess weight [11].)

Pre-existing disease states are shown in table 2. The median duration of inpatient stay was 6 (5–23) days. Major postoperative complications documented in table 3 were those considered to be life-threatening, or those resulting in prolonged hospital stay (duration of stay greater than median duration of hospital stay). Chest infection was diagnosed from an appropriate clinical history and abnormal laboratory investigation, that is microbiology or chest x-ray, and required a hospital stay greater than 6 days. Intensive care admission was required on only three occasions: twice for assisted ventilation and once after acute myocardial infarction.

Thirty-one (15.5 %) patients (3/28 (11 %) male and 28/172 (16 %) female) suffered major postoperative complications; 14 of 200 (7 %) patients suffered cardiovascular complications. Seven thromboembolic events were recorded, including one fatal pulmonary embolus which occurred 3 weeks

Table 1  Patient data (mean (range) or number). n = 200

| Sex (M/F) | 28/172 |
| Smokers/non-smokers | 83/119 |
| Age (yr) | 38.5 (14–60) |
| Weight (kg) | 125.6 (78.0–222.5) |
| Height (m) | 1.62 (1.47–2.00) |
| BMI (kg m⁻²) | 45.7 (30.3–86.8) |

Table 2  Incidence of pre-existing disease. Total number of patients with pre-existing disease = 89. *High incidence (as reported in case records). MI = Myocardial infarction, DVT = deep vein thrombosis
after operation. Four patients suffered uncontrolled hypertension in the first 48 h after operation. Eleven of 81 (14%) smokers compared with 16 of 119 (13%) non-smokers suffered non-surgical complications; seven of 10 (70%) patients suffering non-hypertensive, cardiovascular complications were smokers. Twelve of 200 (6%) patients suffered respiratory complications; four of 12 (25%) occurred in smokers. In our series, 80% of patients with respiratory complications had a BMI greater than the mean (45.7 kg m\(^{-2}\)). In addition, 60% were older than the mean age (38.5 yr) and had a pre-existing disease, most commonly of cardiovascular origin.

Ten of 29 (34%) patients with a history of hypertension suffered non-surgical postoperative complications. Patients who suffered complications had a significantly higher BMI compared with patients who did not suffer complications (\(P < 0.05\)).

**Discussion**

Operative treatment is the only effective measure for the morbidly obese patient. It is associated with long-term weight loss which will correct or improve related conditions, including sleep apnoea syndrome, obesity hypoventilation syndrome, hypercholesterolaemia and hypertension [12].

In two collective studies of 3123 and 5178 bariatric operations, mortality averaged 1.2% and 0.1%, respectively. Selective, postoperative complication rates were 7.3% and 10.3%, respectively [13, 14]. Our own study revealed one death in 200 patients (0.5% mortality) and a 15% major complication rate. The majority of the latter were not life-threatening.

Obesity is a major factor for thromboembolism. Postmortem studies have shown pulmonary embolism to be a more frequent cause of postoperative death in the obese [15, 16]. 125I-fibrinogen scanning has shown that excessive weight is a significant prognostic variable for deep vein thrombosis [17–19]. Obesity predisposes to varicose veins and thrombophlebitis, both considered risk factors. Intraoperative reverse Trendelenburg position and postoperative recovery in the sitting position promote venous stasis. It is also known from laboratory evidence that the concentration of the major endogenous circulating anticoagulant, antithrombin III, is reduced in morbid obesity [20].
diminished circulating fibrinolytic activity, may be restored towards normal by weight loss [21, 22].

The greater the BMI, the greater the risk of failure of low-dose heparin prophylaxis [23]. It is recommended that patients undergoing this operation be placed in a high-risk group [24] and receive specific prophylaxis [25]. Mechanical methods can be combined with anticoagulant prophylaxis which may increase efficiency [26]. Alternatively, an adjusted low-dose heparin regimen may be used. This entails titrating s.c. heparin to maintain activated partial thromboplastin time in the upper normal range [27]. There is evidence in orthopaedic surgery that the low molecular weight heparins are more effective than unfractionated heparins [28].

Pulmonary embolus is the leading cause of death in this operation. In our study there were seven recorded thromboembolic events (3.5%): four deep vein thromboses (DVT) (venogram positive) and three pulmonary emboli (two V/Q scan positive, and one fatal pulmonary embolus revealed at post mortem). In a similar study of 60 patients using s.c. heparin prophylaxis, one DVT and two fatal pulmonary emboli were recorded (5%) [29], and in a study where 70 patients received extradurals, but no specific antithromboembolic prophylaxis, there were five (including one fatal) pulmonary emboli (7%) [30]. The fatal pulmonary embolus in our study occurred 21 days after operation in a patient with a BMI of 67.6 kg m⁻². Similar late deaths have been noted [29] previously and consideration should be given to the duration of prophylaxis [31].

Cardiovascular pathophysiology in the morbidly obese is characterized by increased intravascular volume and cardiac output. Normotensive individuals therefore exhibit reduced systemic vascular resistance. Heart rate is usually not changed significantly; stroke volume and cardiac work are increased. Obesity is an independent risk factor of coronary artery disease. The Framingham study reported an increased incidence of angina pectoris, heart failure and sudden death [32]. Obesity also predisposes to hypertension, diabetes mellitus and hypercholesterolaemia. Fatty infiltration of the conduct system may increase the risk of cardiac arrhythmias [33]. Assumption of the supine position, which leads to a central shift of blood volume and increased preload, is a key factor in cardiovascular tolerance to surgery [34, 35]. Intraoperative depression of cardiac index and left ventricular stroke work is more pronounced and more prolonged after operation in the obese compared with the non-obese [36].

We recorded one anterior myocardial infarction (complicated by cardiac arrest, but good final recovery), one case of angina, one of uncontrolled atrial fibrillation and four patients with severe hypertension after operation. These complications were documented within the first 48 h after operation. Previously, there has been little comment on postoperative hypertensive complications. Hypertension is more common in the obese and mortality is increased in the hypertensive obese compared with the normotensive obese [37]. In our study, 10 of 29 (34%) non-surgical complications occurred in patients with a history of hypertension and 75% of patients whose postoperative courses were complicated by hypertension were apparently receiving adequate antihypertensive medication before operation. Attention must be paid to the optimization and timing of this treatment. An arterial pressure cuff of large width was used during operation but not on the surgical ward. This oversight was corrected early in the series but may have played a part in falsely elevating arterial pressure measurements. Two patients required treatment with sublingual nifedipine to restore arterial pressure to within preoperative levels.

The incidence of postoperative pulmonary complications after routine surgery varies widely depending on the diagnostic criteria used. These complications are more common in the obese, for example after upper abdominal surgery, 18 of 19 (95%) patients weighing 10 kg or more above desirable weight, compared with 17 of 27 (63%) non-obese patients developed pulmonary complications (defined as microatelectasis, macroatelectasis or fever with productive cough) [38]. In non-obese patients, for example after cholecystectomy, postoperative pulmonary complication rates of 75–80% using anticoagulant prophylaxis, one DVT and two fatal pulmonary emboli were recorded (5%) [29], and in a study where 70 patients received extradurals, but no specific antithromboembolic prophylaxis, there were five (including one fatal) pulmonary emboli (7%) [30]. The fatal pulmonary embolus in our study occurred 21 days after operation in a patient with a BMI of 67.6 kg m⁻². Similar late deaths have been noted [29] previously and consideration should be given to the duration of prophylaxis [31].

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The combination of age greater than 59 yr and American Society of Anaesthesiologists (ASA) classification greater than 1 identified 88% of patients who developed postoperative pulmonary complications [40]. Buckley and co-workers [42] noted that 38% of obese patients with co-existing risk factors developed these complications compared with 12% in obese patients free of such risk factors. Optimization of respiratory state before operation should include physiotherapy and bronchodilators, antibiotic prophylaxis and cessation of smoking.

Effective postoperative analgesia must be provided to allow physiotherapy and ensure early mobilization. Benefits have been shown with extradural analgesia in terms of respiratory function, cardiac protection, ambulation and early hospital discharge [30, 42, 48, 49]. However, practical problems with siting extradurals, the requirement for fluoroscopic imaging techniques and extradural failures are encountered. In our study effective postoperative analgesia sufficient to allow mobilization was provided by i.v. infusion of opioid or PCA.

A high dependency unit was not available but would be helpful for postoperative care. We also recommend the involvement of an acute pain team, pain scoring and continuous pulse oximetry. The latter is especially useful in sleep apnoea, which is predictable using neck circumference corrected for height [50]. The patient in our study who suffered a respiratory arrest received an accidental bolus overdose in recovery. No problems were recorded with i.v. opioid administration in the ward.

Finally, the anaesthetist should be prepared for a subsequent anaesthetic in patients who present for plastic surgery, for example abdominoplasty.

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References


