Anesthesia for laparoscopic Roux and Y gastric bypass surgery

1. Pre operative preparation and questions.

Besides the medical history, allergy, drugs used, previous diseases and interventions some extra questions are asked for the anesthesia for laparoscopic gastric bypass surgery.

1.1. Body weight and length allows the calculation of the body mass index (BMI).

1.2. The Waist to Hip ratio (WHR) is calculated by dividing maximum waist circumference by maximum hip circumference. This allows to categorize the morbid obese patient as android (WHR >1,0) or as gynoid (WHR<1,0) In the android group it is important to know if the increased WHR is due to intra abdominal fat or due to extra abdominal fat between skin and fascia. The intra abdominal fat lowers the abdominal compliance and increases the pressure at zero volume (PV0) to an extent in which it is difficult to ventilate the patient, where the surgeon will have no laparoscopic workspace to operate and where the patient will fail to breathe spontaneously after the operation. Moreover the risk for cardio vascular diseases and pulmonary complications is higher.

1.3. The maximum body weight ever reached or the weight reduction achieved in preparation for surgery is important. If an android morbid obese patient or a super obese patient did no achieve a minimum of 10 kg weight reduction, it is better to postpone the surgery and offer a high protein diet or a 6 months intra gastric balloon before surgery.

1.4. An important pre operative question for a woman is the gravidity number as this enlarges the workspace and facilitates the ventilation even when childbirth was many years ago. The same effect is visible for man and woman when previous laparatomies or laparoscopies took place.

1.5. Neck circumference should be measured and a size of more than 40 cm is the best indication for a difficult Intubation in morbid obese patients besides the classical signs of mouth opening.

1.6. History of sleep apnea and the use of CPAP mask at home (ask to take cpap system along to the hospital).

1.7. Diabetes, COPD, arterial hypertension, history of ethyl abuses and smoking habits can make recovery more difficult if not treated accordingly.

2. Pre induction preparation

Have the equipment to position the patient, to handle difficult intubation (video laryngoscope), to give oxygen therapy, to prevent aspiration at start and to maintain anesthesia available before induction.

2.1. Beach chair position (if possible) with elevated upper body before induction improves oxygenation.

2.2. Position an inflatable pillow (safety bird) under the thorax and a pillow under the head to facilitate breathing and intubation.

2.3. Give an oxygen mask (better a boussignac or ventilator connected mask to allow cpap at 5) before induction to increase the oxygen saturation.

2.4. Ask the patient to move the legs and to take deep breaths from time to time after awakening from the operation till the next day to prevent thrombosis and atelectasis, two frequent complications due to anesthesia in morbid obesity.

2.5. Have a good peripheral intravenous line. Look for a large blood pressure cuff on the upper arm or adapt to the underarm if too conical. Use a non invasive continuous finger cuff monitor if available.

2.6. If anesthesia might take more than 2 hours consider an arterial line and a central venous line. Provide an air blanket for warming up and consider an epidural catheter for post operative patient controlled pain treatment.

2.7. Gargling of the oral cavity with Hextril will lower the bacterial load in the oral cavity and lower the endotracheal tip contamination.

3. Anaesthesia induction and maintenance

Following medication is prepared in advance: Dehydrobenzperidol 2,5 mg or 1 ml; Propofol 200 mg and an extra 200 mg ready when needed; Sufentanil 25 ug or 5 ml; Rocuronium 50 mg or 5 ml (and 100 mg or 10 ml for crush induction); infusion drip of Remifentanyl 5 ug/50 ml and of Esmeron 10mg/ml.

3.1. Dehydrobenzperidol is given first in a dose of 1,25 mg to reduce PONV.

3.2. Oxygen is given by mask or better by CPAP mask and induction is started when saturation reaches 95% or more.

3.3. Sufentanil is given in a dose adapted to IBW and not to TBW. A loading dose of 25 ug can be given independent of BMI but adapted to length and age.
3.4. Propofol is given in a dose of 200 mg or more until loss of eyelid reflex or according to entropy or bis level. TBW is not used for dose calculation.
3.5. Rocuronium is given in a minimum dose of 0,6 mg/kg IBW when manual mask ventilation is possible or in a dose of 1,2 mg/kg IBW when crush induction is needed due to super obesity, obstruction (reintervention after lap band, Mason or Sleeve), hiatus diaphragm or a patient not fasted for food or drinks. Clear drinks can be used up to 2 hours. A dose of 50 mg for normal induction and a dose of 100 mg for crush induction are sufficient for every obese patient making exact calculation not necessary.
3.6. The safety bird is inflated till the sterno mandibular distance is more than 15 cm. The sniffing position of the head is kept with an extra tick pillow under the head.
3.7. After minimum 1 minute (or 30 seconds crush) the trachea is intubated with an endotracheal tube preventing silent aspiration. Gel applied on the cuff will help but a taperguard cuff or microcuff gives 100% prevention of silent aspiration.
3.8. Immediately after intubation introduce a gastric tube French 34 gently in the stomach to drain air and gastric content out of the body. Never occlude or suction on the large gastric tube as movements can damage the mucosa and air will enter the intestine and take surgical space.
3.9. Start TOF measurements at ulnar nerve stimulation to guide further rocuronium therapy. Start the rocuronium drip at 5 ml/h and increase when one TOF answer appears or lower when PTC is less than 10.
3.10. Remifentanyl drip is started at 5 ml/h and increased when heart rate or blood pressure increases.
3.11. There is an advantage of inhalation anesthesia versus TIVA. TIVA needs adaptation according to BMI while inhalation concentration is independent of BMI. Bis or entropy monitoring can help to determine the level for both. Inhalation anesthesia does not suppress pressure support ventilation and has muscle relaxing effects that are favorable.
3.12. Inhalation anesthesia with Sevoflurane or Desflurane is given at 1 Mac and adapted according to entropy or bis level. At 2 Mac full relaxation is possible but hypotension at the end is not practical.
3.13. Nitrous oxide can be used safely if intubation was not difficult and no air was inflated in the stomach. It has its known negative effects like PONV and could be omitted.

4. Pneumoperitoneum induction and the need for muscle relaxation

Abdominal compliance is linear in humans allowing the characterization of each patient's abdomen with two parameters: Elastance E or its reciprocal the Compliance C and the pressure at zero volume PV0. Prediction of abdominal compliance remains difficult. Nevertheless some factors like no gravidity, first laparoscopy or no weight reduction in young and sport active patients suggest possible small laparoscopic workspace and higher airway pressures in ventilation. Nevertheless the inter-individual variation in abdominal compliance is that large making the measurement in each individual patient necessary during laparoscopy. The effect of muscle relaxation varies also but it is too difficult to measure this in each patient clinical. Sufficient workspace at the lowest airway pressures requires that every patient should be maximal relaxed

4.1. Verify that muscle relaxation is sufficient deep, TOF 0/4 or 1/4 . Never rely totally on the TOF measurement only. Verify with you hands the finger movements and exclude direct muscle stimulation still possible with full muscle relaxation. Switch electric stimulation and position and repeat.
4.2. Measure during the first inflation the starting pressure and the pressure at maximum volume. This gives you already a rough estimation of the E and PV0.
4.3. Correct measurement is possible when the first trocar is positioned. Measure three pressure volume points at around 1 liter difference. Stop each time the inflator and note the inflated volume as well as the lowest abdominal pressure indicating the end expiratory phase. Draw a linear line through 3 points and calculate PV0 as the crossing with the Y axis and E as the angle of the line.
4.4. Calculate the intra abdominal pressure needed to reach an abdominal volume of 4 liter. Set the inflator to this level or slightly higher. If more than 15 mmHg is needed verify that ventilation is not impaired and keep maximum muscle relaxation till the end. It increases the volume with 600 ml on average. This is the group of patients that might require Bridion for decurarisation.
4.5. Use the beach chair position, anti trendelenburg and leg flexion at the hips, to improve the volume with 700 ml on average for the same pressure.
4.6. After the induction dose subsequent doses should be give in time and before surgeon is disturbed by insufficient place or no place when the patient breaths against the ventilator. The surgeon complaining of no place is always right, as can be the anesthesiologist too, giving total muscle relaxation.

Continuous infusion of rocuronium with TOF monitoring facilitates continuous maximum relaxation. We start a rate of 50 mg/h and increase or decrease according to TOF.

4.7. Maximum relaxation is kept till the end of the pneumoperitoneum in all patients.

4.8. Inhalation anesthetics relax the abdomen only when given in a high dose of 2 MAC. This can be used at the end of the pneumoperitoneum, but is not needed anymore with the availability of Sugammadex.

5. Ventilation of a morbid obese patient

Focused on preventing atelectasis, volutrauma and silent aspiration.

5.1. Peep should be given throughout the entire period as long as the patient is not able to sit up upright.

5.2. The peep level is important to prevent atelectasis, never interrupting even for a short moment, start at a higher level after bag squeezing or need for expansion and come down. Keep minimum between 5 and 10 cmH20

5.3. Bag squeezing helps to treat atelectasis in an early stage, but might be more deleterious. How much pressure and how maintaining an elevated airway pressure is not clear either, but the lower and the shorter the better if at least the oxygen saturation rises within the normal values. If saturation remains low do not prolong the bag squeezing as other factors like low cardiac output could explain low oxygen saturation.

5.4. There is no difference in outcome of controlled volume versus controlled pressure ventilation. Therefore controlled volume ventilation is the first choice as it is safer to prevent hyperventilation and volutrauma or hypoventilation and hypercarbia due to changes in abdominal and thoracic compliance.

5.5. Nevertheless pressure support is chosen when airway pressures are very high as might be the case in android super obese patients.

5.6. Beach chair position is very important for two facts, flexion of the legs and antitrendelenburg Flexion of the legs increases the abdominal compliance and anti trendelenburg allows better diaphragmatic displacement, both lowering the airway pressures certainly in android obese patients and facilitating ventilation.

5.7. I/E ratio of 1:2 might be set to 1,5:2 if no COPD is known. Frequency should rise if tidal volume becomes more than 600 ml (max 6 ml/kg) to keep end tidal CO2 below 40 mmHg.

5.8. Hypercarbia (et CO2 between 50 and 60 mmHg) can be accepted towards the end of the pneumoperitoneum as it increases the cardiac output. The improves peripheral organ perfusion, what lowers wound infection, prevent ischemia around the staple lines and increases blood pressure needed to find bleeding spots on the staple lines. Most patients have chronic hypoventilation with hypercarbia making the need for normocarbia during surgery questionable.

5.9. Pressure support ventilation is possible even in a patient under full muscle relaxation when the morfinomimetic dosage is limited. At the end of the laparoscopy when end tidal CO2 is allowed to raise pressure support can easily started even during pneumoperitoneum. Breathing against the ventilator disturbs the surgeon while the ventilator following the patient's respiration will be almost not visible for the surgeon if rate is low and muscle relaxation is maintained.

5.10. Pressure support ventilation allows the up titration of the morphine dosage till respiratory rate drops below 20 breaths per minute. If respiratory rate is below 10 support should be postponed till morfinomimetic concentration drops.

5.11. When muscle is decurarized patient can develop more force allowing the support level to drop while keeping tidal volume sufficient. Peep should never be interrupted. When support of 5 cmH20 is reached patient can breath spontaneous, ideal while keeping cpap at 5 cmH20

6. Assisting the surgeon in positioning the gastric tube and performing the leak test.

Correct position of the gastric tube and emptying of the stomach is important for the surgeon. Never insert deeper if resistance is felt and learn to use the laparoscopic view when possible.

6.1. First deflate the stomach, never suction on the 34 French tube but keep tube always open and in drainage.

6.2. Retract the tube in the esophagus while keeping it open.

6.3. After the first staple line introduce the tube slowly in the base of the gastric pouch created by the next stapler.

6.4. Advance one centimeter to keep traction on the pouch while the surgeon dissects and places the third stapler. When the stapler is fixed ask to move the tube a little bit up and down to verify that the stapler is not put on the tube.

6.5. When the pouch is created redrawn the tube again in the esophagus.

6.6. At the end of the operation the gastric tube is reinserted under laparoscopic view and stopped 5 cm below the gastro jejunostomy. The surgeon closed the descending jejunum and 150 ml methylene blue colored water is injected by the anesthesiologist as fast as possible to distend the gastric pouch to a

volume load. Tube is closed and 150 ml air is extra injected for further distension and evaluation of leakage. The tube is slowly withdrawn while opened to the air, to evacuate the water. Extra stitches are placed if needed and a repeat leak performed. When extra stitches are placed over the gastro jejenostomy the leak test should be performed a little slower to prevent incision of the mucosa through the stitches.

6.7. The tube is withdrawn in the esophagus and kept draining the fluids and air.

7. Blood pressure increase to prevent post operative bleeding and revision.

The quality of laparoscopic staplers has increased in the last decennia improving tightness and preventing bleeding. Extra layers between staplers and gastric wall should further improve the quality. Nevertheless some blood vessels might start to bleed post operatively when systolic pressure increases due the patient wake up and pain reaction. Therefore an arterial pressure increase during the operation is important to visualize and correct possible bleeding before any problem set in.

7.1. At a SAP below 90 mmHg al staples lines are totally white without any bleeding spot. This might be nice for the surgeon to operate in a blood free workspace but has a risk when blood pressure rises without inspection.

7.2. At a SAP of 110 mmHg staples lines are oozing and get a red appearance. It is important to maintain this pressure during the stapling to ensure that no ischemia will take place certainly in re interventions with unclear perfusion anatomy.

7.3. We increase the SAP to 140 mmHg at the end of the operation to verify any possible bleeding spots that otherwise might have missed and could create an emergency reintervention during the night.

7.4. The surgeon can easily put some extra stitches or a staple on the blood vessel, better than to coagulate the staple line and impairing perfusion.

7.5. This also the good moment to verify that all tissue is well perfused and has a nice red color.

8. ERAS techniques to shorten turn over time and improve post operative recovery

Early recovery after surgery (ERAS) starts already at the induction. Many factors that favor ERAS are discussed supra.

8.1. Avoid the use of long working sedatives like benzodiazepines as it is important to have morbid patients as soon as possible full awake after the operation.

8.2. Inhalation anesthesia makes ERAS easier to apply. Also if a high dose of 2 MAC is needed for relaxation at the end. The choice for desflurane, having the lowest absorption, is then justified. When rocuronium is used full IV muscle relaxation is possible till the end, given Sugammadex is available.

8.3. Stop remifentanyl infusion and switch to pressure support ventilation first at the support level that was used during pressure controlled ventilation. Take 5 cmH20 less than the measured peak pressures in case volume controlled ventilation was used.

8.4. Measure TOF and decide what decurarisation is needed to reach 90% at the end of surgery. If TOF < 2/4 2 mg/kg Sugammadex is given, if TOF is between 2/4 and 4/4 1 mg/kg Suggammadex is given. If TOF is 4/4 neostigmine is able to work sufficiently but Suggammadex might be used at a dose of 0,5 mg/kg to stimulate awakening. Sugammadex should be given when patient is fixed with belts after the last surgical stitch to prevent patient from falling of the OR table. (Official dosage is based on TBW but unpublished data suggest that this might be lower and that IBW could be used. Nevertheless measure the TOF and adapt the dosage is needed.)

9. Extubation, post operative assist and the decision for intensive care follow up.

Patient can be extubated when spontaneous tidal volume is more than 200 ml and patient is fully decurarized and awake.

9.1. First aspirate the oral cavity and go down with aspiration tube just into the gastric pouch. Emptying the stomach will make patient more comfortable but allow visualizing any internal bleeding not notified during laparoscopy.

9.2. Put patient in beach chair position, if table allow positioning.

9.3. If Sugammadex is used the arousal effects might be that strong that patient is able to move himself in bed from the table.

9.4. Post operative CPAP at 5 cm H2O is safe and will not distend the gastric pouch.

9.5. If even with full decurarisation patient fails to breath sufficiently, do not wait until hypercapnia creates somnolence and further compromises ventilation.

10. Post operative pain treatment

10.1. Post operative pain treatment is important but less difficult in laparoscopy compared to laparotomy.

10.2. Give perfusalgan 2 gr loading dose when BMI > 40 and repeat every 4 hours with 2 gr
10.3. Give sufficient Sufentanil per op at induction or titrate at the end when PSV is started. If patient breathe more than 20 x /min extra small bolus can be added till respiratory rate becomes 14. if lower than 10 wait with PSV
10.4. provide dipi iv 5 mg every 30 min as long as RR > 20 in the Paza until patient is pain free
10.5. provide 20 mg IM of dipidolor and increase to max 30 mg if patient is a man, tall, muscles besides a BMI > 50
10.6. TAP blocks seems promising but should be placed higher under echo to have upper abdominal wall block.
10.7. PCEA is more difficult to start, but if time expertise and followup possibilities this is still superior in pain management.
10.8. Local wound infiltration of the trocars can be helpful but does nothing for the diaphragm pain.
10.9. Less diaphragm pain is seen in patients having multiple laparoscopy or multigravidity indicating that less fascia hyper extension took place.

Techniques described hereby are used by
and are partly common knowledge, partly invented by

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