PATIENT POSITION DURING ANESTHESIA

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Lecture Objectives

- Gain an understanding of safe positioning basics
- State the correct hand and arm positioning for supine, lateral decubitus and prone positions.
- Be able to recite the potential nerve injuries of each patient position.
- Identify the complications of the sitting position.
OBJECTIVES CON’T

- Define and understand the hemodynamics of each patient position.
- Understand and be able to verbalize the respiratory responses of differing patient positions while awake and under general anesthesia.
- Understand the process and risks of Field Avoidance – the turned patient.
- Discuss Post Operative Visual Loss (POVL) Case Study: Complications of Prone position
Look for Key Points

- Positioning is often a compromise between what is required for surgical exposure and patient comfort! Do not place sedated or anesthetized patients in positions that they are not comfortable with when awake.
- If in doubt about patients safety have the patient assume the position on the OR table before induction to see how they tolerate the position.
- Patient positioning is the joint responsibility of OR Nursing, Anesthesia and Surgery. All three individuals and groups that represent them will be held liable if errors in positioning cause patient harm. Document!
The only thing that represents what was done in the operating room in a court of law is your testimony and your documentation. How much do you think you can remember from one case to the next and how much of your “story” will the court officers “believe” without your careful documentation in the anesthesia record?

What to document? Pre-operative patient limitations in movement strength and nerve abnormalities. Does the patient have numbness tingling or loss of sensation to any extremity pre-operatively? Does the patient have foot drop?
**Mask Injuries**

- Potential for corneal abrasion is always present when mask ventilating patients.
- Keep hanging badges away from the patients face when hand ventilating (don’t use the term "Bagging the pt").
- Always remember the ABC’s.
- Where does “E” come in the ABC lineup?
- When do you tape the eyes closed knowing all of the above. A controversial question.
**Masking Injuries**

- Face straps which are tight across the patients face with prolonged use may cause injury to the facial nerve. What are the five branches of the facial nerve remembering the mnemonic, “Two zebras bit my cat” The bucal branch is most likely injured with a face strap compression.
  - Temporal
  - Zygomatic
  - **Bucal**
  - Mandibular
  - cervical
DORSAL DECUBITUS POSITIONS

- Humans, giraffes and dinosaurs share one thing in common. What is it?
- Gravity effects blood flow and much of pulmonary mechanics.
- In the supine position gravity equalizes blood pressure gradients between heart and arteries in the head and lower extremities.
Correct Anatomical Position

- What is the ventral surface?
- What is the dorsal surface?
- Note: Dorsal to dorsal and ventral to ventral
**Hand Positioning**

- Lying at attention requires correct arm and hand position to minimize the chances of nerve injuries.
- Arms are to be less than 90 degrees lateralized from the thorax in correct anatomical position looking at the shoulders. This will minimize the chance of brachial plexus injury.
HAND POSITIONING

- Arms at side of body must be in correct dorsal to dorsal alignment with the arms supinated OR palms toward the body is OK as well. The ulnar nerve passes close to the surface of the skin in the medial condyle of the elbow. The olecranon will protect the nerve if placed downwards.
- Radial nerve injury is possible with ether screen compression to the lateral arm. Radial nerve injury may result in wrist drop.
What is Supination

- Correct anatomical position is lying at attention
- Palms are ventral surface so ventral to ventral
- Dorsal to dorsal mean back of hands to down in the supine position.
DORSAL DECUBITUS POSITIONS

- Head tilt either upwards or downwards will change the pressure gradients. A movement of 2.5 cm in vertical elevation will change the blood pressure 2 mm Hg.
- In the parturient an IV bag under the right hip will shift the gravid uterus to the left. Have you heard of Aorto-caval syndrome?
**Head down things**

- Lowering the head will increase the pressure in the cerebral veins which may lead to vascular headache, congestion of nasal mucosa and conjunctiva in healthy individuals. This may lead to edema in the larynx as well. The sclera is the window to the vocal cords!

- Head lowering in patients with intra-cranial lesions will exacerbate the condition raising CPP and ICP (what's the formula for this?)
AUTONOMIC FUNCTION

- Aortic arch and carotid sinus house baroreceptors that are part of the body's homeostatic mechanism to maintain blood pressure within a narrow range. Increased firing of the receptors when stretched from an increase in blood pressure is part of a negative feedback loop.

- The increased firing from the baroreceptors enhances the parasympathetic nervous system lowering blood pressure and slowing the heart rate. Remember this!

- What are the afferent and efferent nerves responsible for the baroreceptor reflexes?
Autonomic Nervous System

- The carotid sinus baroreceptors are innervated by the sinus nerve of Hering part of glossopharyngeal nerve. The glossopharyngeal nerve synapses in the nucleus tractus solitarius.
- Aortic arch is innervated by Vagus.
- Stimulation of the NTS causes firing of efferent Vagus.
**Respiratory Effects**  
**Awake vs Anesthetized Patient**

- Is there a difference in the respiratory effects between an awake and anesthetized pt?
- Awake pt’s maintain V/Q matching whether standing, lying down or side lying.
- In an anesthetized paralyzed pt V/Q matching is not maintained. Why?
Respiratory Effects

- Respiratory mechanics will suffer in the head down position how? Review West’s zones of the lung.
- Zone 1 PA>Pa>Pv
- Zone 2 Pa>PA>Pv
- Zone 3 Pa>Pv>PA
TRENDELENBURG RESPIRATORY ISSUES

- Normal excursion of the diaphragm in head down position is impeded and increase the work of breathing. In the paralyzed mechanically ventilated patient, higher peak pressures will be required for adequate ventilation.
Supine patients develop VQ mismatch due to vascular congestion in the dorsal portions of the lung and changes in compliance. The dorsal lung (now zone 3) will have reduced compliance. Passive ventilation tends to distribute gas preferentially to the more easily distensible substernal units where pulmonary blood flow volume is less (Barish, 2006).
More Respiratory Things

- To prevent development of significant V-Q imbalance during use of controlled ventilation, tidal volumes must be used that are greater than the average amount that is sufficient for the spontaneously breathing conscious pt.

- Compare and contrast the awake spontaneously breathing pt and the paralyzed mechanically ventilated pt in the lateral position.
OH NO MR. BILL HIGH PEAK PRESSURE

- How would you attempt to decrease Peak pressures during mechanical ventilation in the paralyzed anesthetized patient?
  - Hint: deepen anesthetic, muscle relaxation, decrease Vt and increase Rate, change I:E ratio from 1:2 to 1:1.5.
  - Consider Pressure Control ventilation due to its decelerating waveform.
Airway Issues with Head Down

- Which way will an intubated patient's ETT migrate when placed in Trendelenburg position?
- Does the Peak airway pressure increase when the patient is positioned head down? By how much.
- Recheck breath sounds after a position change especially if peak airway pressures change.
- Right main stem intubation can be an issue when placing the patient in steep Trendelenburg position. Trust me it happens.
VARIATIONS IN THE DORSAL DECUBITUS POSITION

- Supine otherwise known as lying at attention. Places strain on lower segments of lumbar spine.
- Lawn chair is a more physiologically tolerated position due to decreased stretch on lower back.
- Frog leg (heal to heal with lateralization of knees) for peroneal examinations may place excessive stretch on back, hips and pelvic structures. Pad under knees. Complications of excessive stretch may include 1) postoperative hip and back pain; 2) dislocated hip or fracture of an osteoporotic femur; 3) obturator nerve injury.
Complications of Dorsal Decubitus

- Pressure Alopecia due to prolonged compression of hair follicles. Most alopecia occurs between the 3rd and 28th postoperative day while re-growth usually occurs within 3 months (Barish, 2006).
- Placement of gel pad or donut under head is worthwhile. Frequent repositioning of the head is warranted.
COMPLICATIONS OF DORSAL DECUBITUS

- Pressure point reactions occur when bony prominences are unsupported for prolonged periods. Hypothermia and hypotension enhance the ischemic process. The heels, elbows and sacrum should be gel padded. NOTE: There are no studies proving decreased incidence of peripheral neuropathies due to gel padding.
- Back pain due to loss of lordosis. Lawn chair position best.
Lithotomy Position

- Lithotomy position traditionally has been used during gynecologic and urologic surgery. The hips are flexed 80 to 100 degrees and the hips are abducted 30 to 45 degrees from midline.
- Hip flexion greater than 90 degrees may cause stretch of the inguinal ligaments and impinge the lateral femoral cutaneous nerves which pass through the inguinal ligament which leads to numbness in the lateral thigh.
LITHOTOMY POSITION

- The legs should be moved into and out of position simultaneously. The knees are brought to midline and the legs slowly unflexed to the supine position at the end of the surgical procedure.
COMPLICATIONS IN LITHOTOMY

- Leg elevation causes increase in venous return and transient rise in CO and ICP. Alterations in pre-Load is most responsible for hemodynamic changes during anesthesia.
- Abdominal viscera is displaced cephalad decreasing Vt and increasing peak pressures.
COMPLICATIONS IN LITHOTOMY

- Back pain from loss of lordotic curvature of spine in lithotomy position.
- DANGER to fingers. Watch carefully when hands are tucked and raising or lowering foot board.
- Compartment syndrome is a rare complication but occurs in lithotomy position due to inadequate perfusion to the raised extremity.
MORE COMPLICATIONS OF LITHOTOMY POSITIONING

- Ischemia, edema and the possibility of rhabdomyolysis occurs from the increased pressure in the fascial compartment.
- For you number heads, compartment syndrome occurred in about 1 in a million for patients in supine position and about 1 in 9,000 for pts in lithotomy position. What do you think about lithotomy? I think Danger!
Lithotomy Complications

- Injury to the common peroneal nerve. This is the MOST COMMON nerve injury to the lower extremities accounting for 78% of all lower extremity motor neuropathies caused by compression of the nerve between the lateral head of the fibula and “candy cane” bar stirrups.
- Duration of surgery greater than 2 hours is a predictor of increased incidence of lower extremity neuropathy.
**Lateral Decubitus Position**

- Lateral decubitus position is used for surgeries on thorax, retroperitoneal structures or hip.
- V-Q mismatch increases due to gravitational forces. Perfusion is greatest in dependent structures or down lung while ventilation is better in nondependent lung.
CHEST ROLL ANYONE?

Use of “Chest Roll” incidentally misnamed axillary roll. The presence of the chest roll is to prevent compression injury to the brachial plexus. Monitor the pulse in the dependent arm please.
Lateral Decubitus Position

- Non dependent arm is “air planed” or supported with pillows and not allowed to be abducted greater than 90 degrees.
- Place pillow between knees with dependent leg flexed.
- Pressure points include acromion process, iliac crest, greater trochanter, peroneal nerve and lateral maleolus.
Complications of Lateral Decubitus

- Eye and ear injuries. Make sure that downside ear and eye are “free” from pressure. Use a donut roll for the ear. Use of the Opti-guard or eye guard is considered useful in lateral positions.

- Neck flexion needs to be avoided. Position neck midline with supporting towels.
COMPLICATIONS OF LATERAL DECUBITUS

- Suprascapular nerve stretch from the circumduction of the dependent shoulder. The chest roll should prevent this.
- Long thoracic nerve injury from lateral decubitus position has been documented. Winging of the scapula is the typical clinical sign. The serratus anterior muscle is solely supplied by the long thoracic nerve which branches from C5 C6 and C7.
Kidney Position

- Kidney position is a flexed lateral decubitus position where the table is flexed to “open up” the lateral structures for surgical exposure.
- Flex point should be under iliac crest not rib cage.
**Kidney Position**

- Stabilize the patient to prevent movement and shifts caudad on the table so that the kidney rest may not relocate itself into the downside flank.
- Ventilation issues again may occur due to dependent lung compromise and V-Q mismatching.
PRONE POSITIONING

- Prone position is primarily used for surgical access to posterior aspect of the spine, posterior fossa of skull, buttocks and perirectal areas or posterior portions of the lower extremities.

- Prone positioning requires planning. Induction and intubation of the trachea is accomplished while patient is supine on stretcher. IV access is performed as well as arterial catheter placement prior to turning prone on operating room table.
PRONE POSITION

- Could you place a central line emergently in a prone patient? Plan ahead.
- Would you consider use of LMA or extubation in the prone position?
Supporting Devices for Prone

- The head is supported usually midline. Mayfield tongs are used for craniotomy cases in the prone position. At LAC we use the Prone View with a mirror to see the facial structures while the patient is prone.
- Turning the head to the side may be used but lateral rotation of the neck may compromise carotid or vertebral arterial blood flow and may restrict venous drainage.
- Eye protection is required.
SUPPORURING DEVICES FOR PRONE

- Support of the thorax with firm bolsters which are placed under the patients sides from clavical to i lac crest. This allows the belly to hang free and increases ventilation while preventing aorto-caval compression.

- Breasts are placed medial and cephalad while genitals are insured to be non compressed.
ARM PLACEMENT IN PRONE PTS

- Placement of the arms is either at the sides of the patient or forward alongside the head on padded arm boards.
- Padding of the elbow is required.
- Abduction of the arms should be limited to less than 90 degrees to prevent excessive stretch of the brachial plexus.
Bolsters and Arms in Prone

- Ankles may be supported with a bend in the knees to reduce stretch to the lumbar spine.
- Calf compression stockings are routinely used to prevent venous stasis or blood pooling with reduction in DVT.
Complications of Prone Position

- Prone position is one of the more challenging positions to the anesthetist.
- Eye and ear injuries are more common in this position. Eye protection with Opti-guard is warranted. Scleral edema is common in prone patients.
- The Sclera is the window to the pharynx. Edema of the sclera is a danger sign.
MORE COMPLICATIONS

- Blindness. Permanent loss of vision can occur after nonocular surgical procedures especially in patient in the prone position! Spine surgery with its blood loss, hypotension and anemia may all conspire together to produce optic nerve ischemia.
**Additional Prone Problems**

- Neck injuries due to misalignment.
- Brachial plexus injuries due to excessive stretch or misalignment of shoulders.
- Breast or genital injuries causing pain or dysfunction. Not good. Medial placement of breasts is recommended.
- Abdominal compression injuries may be alleviated with the use of bolsters.
**PRONE PROBLEMS**

- Knee injuries are especially prevalent in the obese or in those with pathologic conditions of the knees preoperatively. Document and pad the knees heavily.
- Injury to the dorsum of the feet is also possible.
PRONE PROBLEMS

- Thoracic Outlet syndrome. How do you test for it?
- Did you forget about POVL in the Prone position?
- Are you excited yet about doing anesthesia?
SITTING POSITION

- See attached article in anesthesia patient safety newsletter.
- Beach chair position may cause decreased cerebral perfusion, CVA, and brain death - really.
- Apsf Newsletter article READ IT!
- Major risk of sitting position is **hypotension**.
- Most serious complication of the sitting position is AIR EMBOLIS.
SITTING POSITION MAYFIELD TONGS

- Sitting position is often used for outpatient shoulder surgery and posterior fossa approaches
- Hemodynamic effects can be dramatic. Pooling of blood in the lower part of the body and the subsequent decrease in cerebral perfusion.
SITTING POSITION BP ISSUES

- For every inch in distance change of cuff position there is a 2 mm Hg rise or drop in mean arterial pressure.
- Often in shoulder surgery while in the sitting position the surgeon “requests” hypotension – really it’s true!
Cuff Position Effects Brain CCP

- To measure the hydrostatic gradient, there is a 0.77 mmHg decrease for every centimeter gradient (1 mmHg for each 1.25 cm).
- In general, the approximate distance between the brain and the site of the BP cuff on the arm in the seated position will be 10-30 cm depending on the angle of the sitting position and the height of the patient.
- The brain MAP will be 8-24 mmHg lower than the measured mean brachial artery pressure. If the beach chair position is combined with the use of deliberate hypotension, cerebral perfusion may be severely compromised.
MORE CUFF POSITION THINGS

- An even more exaggerated occurrence may develop when the BP cuff must be placed on the leg because the contralateral arm is not available for BP measurement, e.g., in a patient with prior lymph node dissection for breast cancer.

- In the beach chair position, the legs are considerably lower than the trunk, therefore the BP difference between the BP cuff measured on the leg and the BP in the brain will be even greater than the gradient between the arm and the brain.
COMPPLICATIONS OF SITTING POSITION

- Potential complications due to flexion of the neck which can impede both arterial and venous blood flow through the neck.
- Flexion of the endotrachial tube may lead to excessive pressure on the tongue leading to macroglossia.
SITTING PROBLEMS

- Neck flexion may be measured and kept to acceptable limits with two fingerbreadths distance between chin and sternum.
- Venous air embolism is a serious complication of sitting position and the reason for its rare use. This is possible whenever the operative site is above the level of the heart.
Venous Air Embolism

- This life threatening condition may occur any time a surgical site is above the level of the heart.
- There are no valves in the cerebral venous circulation and the risk of venous air embolism is constant in the sitting position when the operative site evolves the posterior fossa or may occur in spinal surgery when prone! Remember this!
Venous Air Embolism

- Venous air embolism may be manifested as cardiac dysrhythmias, arterial oxygen desaturation, drop in End Tidal CO2, pulmonary hypertension or frank cardiac arrest.
- Actions to take if you suspect an air embolism is to ask the surgeons to flood the field with saline and to apply bone wax to boney edges. For further discussion refer to your neuro lecture.
POSITION CHANGES

- Simple surgeries that require only one position are the easiest – of course. Supine is Sublime.

- Often, however, surgeries require multiple position changes during the operation or field avoidance maneuvers (turning the patient 180 degrees away).

- Field Avoidance is a maneuver where the patient’s head is turned away from the anesthetist either 90 or 180 degrees. What would you do differently if the patient is turned 180 from you?
**Turned Patients**

- Before putting on the monitors ask the surgeon and circulating nurse which way the patient will be turned.
- Plan on placing monitors so that when the patient is turned your cables will not create a spaghetti mess.
- Enter cables away from the direction you plan on turning.
- What about your airway. Not having the patient’s head available to you makes for extra care.
AIRWAY IN A TURNED PATIENT

- Use a flexible connector between the ETT and the anesthesia circuit.
- Make sure connections are tight – really.
- ENT cases the surgeons love to extend the neck a long way. What does extending the neck do to the ETT position within the trachea?
- Chin up puts ETT up or down? Recheck breath sounds and ETT placement following all position changes.
- Beware!!!!!!!
Overview of Nerve Injuries

- The Closed Claims Project conducted by the ASA evaluated adverse anesthetic outcomes in 1990.
- **Ulnar neuropathy remains the MOST frequent (28%) of all nerve injuries** followed by brachial plexus (20%).
- Etiology of peripheral nerve injuries remains largely unknown. Most of the nerve injuries to ulnar and brachial plexus occurred in patients with proper positioning and adequate padding.
- Ulnar neuropathy results in an **inability to abduct or oppose the fifth finger**, diminished sensation in the fourth and fifth fingers and eventual “**claw**” hand.
Ulnar Neuropathy

- Current thinking is that ulnar neuropathy is multifactorial and not always preventable despite routine use of arm boards and padding. Ulnar neuropathy is most common in older men, diabetes mellitus, vitamin deficiency, alcoholism, cigarette smoking and cancer.

- Prevention? Avoid excessive pressure on the postcondylar groove of the humerus, limit abduction of the arm to less than 90 degrees, keep the hand and forearm either supinated or in a neutral position with palms facing thigh.
**Brachial Plexus Injury**

- The brachial plexus is subject to injury due to stretching or compression as a result of its long superficial course in the axilla.
- Arm abduction greater than 90 degrees, lateral rotation of the head, asymmetric retraction of the sternum and direct trauma all may contribute to brachial plexus injury.
- Cardiac surgery and sternotomy is associated with a higher incidence of brachial plexus injury.
More Brachial Plexus

- Shoulder braces have historically been a culprit in brachial plexus injury leading to their rare use. The compression of proximal roots or lateral displacement of the braces can stretch the plexus when the shoulders are displaced.
- Use non sliding mattress instead of shoulder braces.
LOWER EXTREMITY NERVE INJURY

- Lithotomy position is associated with injury to common peroneal and sciatic nerves.
- The sciatic nerve may be stretched with external rotation of the leg or with hyperflexion of the hips and extension of the knees.
- The Saphenous nerve may be injured if the medial knee is compressed.
Lower Extremity Nerve Injury

- The common peroneal nerve which is a branch of the sciatic may be injured with compression between the head of the fibula and the metal frame of “candy cane” stirrups when the patient is in the lithotomy position. This is the Most common nerve injury in lower extremities!

- Common peroneal nerve injury results in Foot Drop!
MORE NERVE INJURY STUFF

- Median nerve injury may be caused by “searching” for an IV in the anticubital fossa resulting in the inability to oppose thumb and the little finger.
- The postoperative neuropathy that must be referred to a neurologist immediately is any MOTOR deficit following surgery.
THANK YOU

- Thank you for your attention and I am looking forward to seeing you in the OR.
- So what is it like on the other side of that steep mountain?
CASE STUDY: POVL IN PRONE POSITION

- A 58 year old anesthesiologist has chronic back pain and is scheduled for laminectomy at a University Medical School Teaching hospital. The case is scheduled for 6 hours but runs over - really? Of course - this is a prone position case with over 500 ml of blood loss.
Case Study

- After the successful completion of the surgery the patient has visual complaints including flashing colors. Fundoscopic exam was normal. Over the next weeks a visual field of vision loss of 70 percent is reported.
CASE STUDY

- Discussion: What are the data concerning POVL.
- What roll does anesthesia play in the informed consent for prone cases?
- What is the liability of the anesthesia provider for POVL?
REFERENCES

-apsf Newsletter, “If my spine surgery went fine, why can’t I see?” Vol 23, No. 1, 1-20.
-Bararsh all of it!