Safe Patient Positioning: How to Mitigate Risk in All Perioperative Phases of Care

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Continuing Nursing and Allied Health Education Provider

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OVERVIEW

An evidence-based and team-based approach for positioning is needed to ensure a safe surgery. Serious patient injuries can occur if a surgical patient is not correctly positioned, including permanent damage to nerves. Evidence-based guidance from AORN and other safety sources outlines specific safe positioning recommendations for all surgical positions, including high-risk positions such as steep Trendelenburg. Using the correct positioning device(s) is also essential to provide safe patient positioning and this must be done in accordance with the manufacturer's instructions for use. Advanced planning provides teams with the time and coordination to develop a plan for patient positioning that not only ensures patient safety but also optimizes workflow, device selection/availability and staff time.

Learner Objectives

After completing this continuing education activity, the participant should be able to:

1. Review common positioning injuries during surgical procedures.
2. Describe high-risk surgical positions along with potential associated injuries.
3. Outline team collaboration, communication and workflow strategies that can be implemented into practice.
4. Identify safe patient positioning strategies and techniques based on evidence-based guidelines for, Steep Trendelenburg, lithotomy, Beach Chair, lateral, and prone positions.
5. Verbalize correct device usage for the to protect the patient during surgery.

Intended Audience/ Educational Need

This continuing education activity is intended for a perioperative nurse or other healthcare professional who wants to learn more or needs to gain knowledge and skills in acute ischemic strokes.

Teaching Methodologies

This continuing education activity is governed by principles of adult learning. PowerPoint images will be used to augment the speaker's presentations and a supportive study guide with content and references is provided to each participant. Attendees will have an active role in discussion as well as opportunities to ask questions and share experiences.

Steps For Successful Course Completion

To earn continuing education credit, the participant must complete the following steps:

1. Attend the course presentation, view course content and review learner objectives.
2. Log into the link provided during the presentation.
3. Complete the post-test to access the evaluation in the menu.
4. Finish the course evaluation to complete and receive credit for this activity.
5. Upon course completion of the above requirements, a Certificate of Attendance is awarded. This Certificate is found in your MyLearning profile on the Pfiedler Education website.

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Obtaining full credit for this offering depends upon attendance, regardless of circumstances, from beginning to end. Licensees must provide their license numbers for record keeping purposes.

The certificate of course completion issued at the conclusion of this course must be retained in the participant's records for at least four (4) years as proof of attendance.

NCCT

The National Center for Competency Testing (NCCT) has approved this program for 2.0 contact hours.

Expiration Date

This continuing education activity was planned and provided in accordance with accreditation criteria. This material was produced in January 2022 and expires January 2024.

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INTRODUCTION

Knowledge helps the perioperative team **identify and assess at-risk patients to avoid injuries from improper and prolonged positioning.**

The surgical team is responsible for the safety of patients and each other in each area of perioperative care. One way to ensure safety is through proper surgical positioning. Proper positioning of the surgical patient enables optimal access and exposure to the operative site, while maintaining structural integrity and body system function. If patient positioning is performed incorrectly, patients can sustain injuries to the circulatory, integumentary, respiratory, circulatory and neuromuscular systems. It is important that perioperative nurses and surgical technologist have the knowledge to identify and assess at-risk patients so that an appropriate plan of care is developed, evidence-based interventions are implemented, and the patient remains free of injury related to improper and prolonged positioning. This knowledge can also help members of the perioperative team avoid work-related injuries from moving or lifting patients improperly during the positioning process.

UNDERSTANDING POSITIONING INJURIES

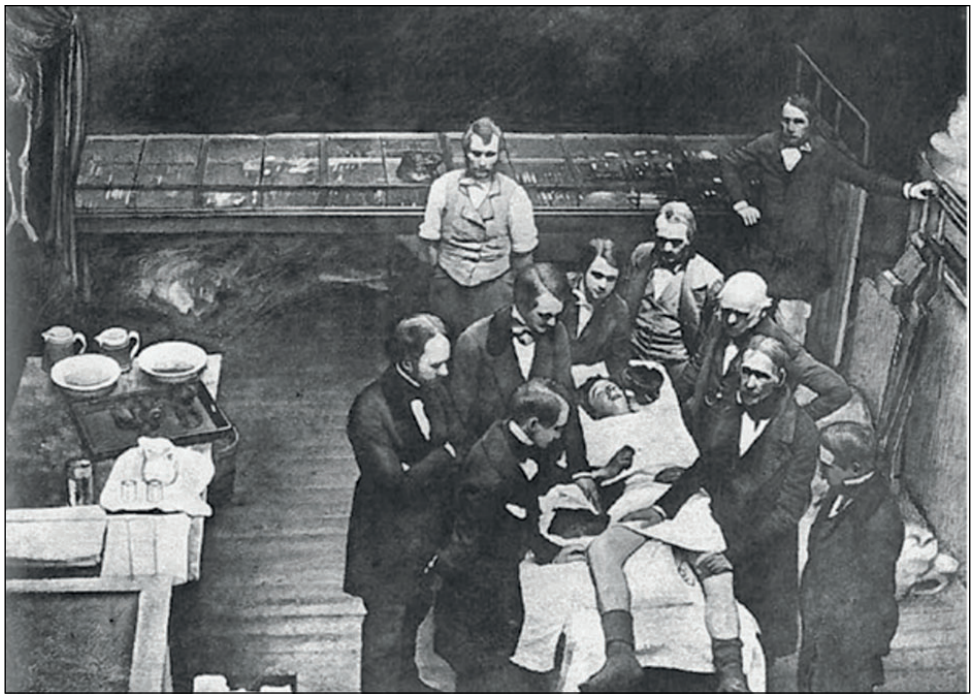
"Some patient positioning injuries are permanent, leading to long-term functional restriction or even death."

Surgical positioning generally occurs after induction when patients are unable to adjust from an uncomfortable position that compresses nerves and skin and reduces blood flow. Prolonged procedures increase these positioning injury risks. It is likely that surgical positioning injuries were first recognized as anesthesia emerged as early as 1846 when William Morton of Massachusetts General Hospital introduced inhalation gas for patients to prevent them from feeling pain.[1] During this time, and before patient positioning injuries during surgery were well understood, they were extremely common, dangerous, and often deadly. Today, research and evidence-based guidance helps perioperative professionals and positioning device manufacturers understand how patients' bodies can be safely positioned and monitored during surgery to prevent injury.

Positioning injuries can affect anatomic locations, including skin and soft tissues, joints, ligaments and bones, eyes, nerves, and blood and lymph vessels. Several factors affect these body systems, including:[2]

- type of procedure performed;
- type of surgical position;
- duration the patient remains in the surgical position;
- operating room (OR) bed, padding, and positioning equipment/devices used; and
- type of anesthesia.

Patients can experience positioning injuries that quickly resolve once their position is changed. However, some injuries are permanent, leading to long-term functional restriction or even death.[3] For example, there have been documented cases where



Hawes, Josiah Johnson, 1808-1901. and Southworth, Albert Sands, 1811-1894., "Photographs of Early Ether Anesthesia 0perations at Massachusetts General Hospital," OnView: Digital Collections & Exhibits, accessed December 29, 2021, https://collections.countway.harvard.edu/onview/items/show/18185.

poor proning techniques caused inappropriate amount of pressure on vital structures of the abdomen that led to ischemia and organ failure.[4] It is important to have a thorough understanding of anatomic and physiologic changes that can occur as the result of positioning and that these changes can affect the skin and underlying tissue; musculoskeletal, cardiovascular, nervous, and respiratory systems; and other susceptible areas, such as the eyes, fingers, breasts, and perineum.[2]

Skin and Soft Tissue

One of the primary considerations for patient positioning, especially during prolonged procedures, is compression and damage to the skin and soft tissue. External skin pressure over normal capillary interface pressure (ie, 23 to 32 mm Hg) can lead to capillary occlusion and impede or block blood flow.[5] High pressure for a short duration and low pressure for a prolonged duration are risk factors for a pressure injury, and the resulting tissue ischemia leads to tissue breakdown. To mitigate this risk, perioperative team should ensure that the patient's bony prominences and equipment held against the patient are properly padded to avoid undue pressure on the skin and soft tissues.

Nerves. Nerve injuries mostly occur secondary to external compression or stretching. The most commonly injured nerve is the ulnar nerve from improper positioning of the upper extremity in the supine position when the arm is not supinated or in the neutral position and abducted no more than 90 degrees from the body.[6,7] Lower extremity nerve injuries are less common, but precautions should still be in place. Common peroneal nerve compression can occur from direct compression over the fibular head and sciatic nerve stretch can result from flexion at the hip (lithotomy position).[8,9]

Assessment of nerve dysfunction may lead to early recognition and treatment of peripheral neuropathies. Signs of nerve injury include a decreased range of motion, impaired limb muscle strength, numbness or tingling, or pain in the limbs or joints not associated with the procedure. Symptoms may appear days or weeks following the procedure if symptoms are confused with pain or immobility caused by the procedure.[10,11]

Muscles and joints. Muscle strain can result from the patient's inability to react to the movement of the extremities. Muscle and joint injuries are especially a risk when care is not taken to move extremities simultaneously.

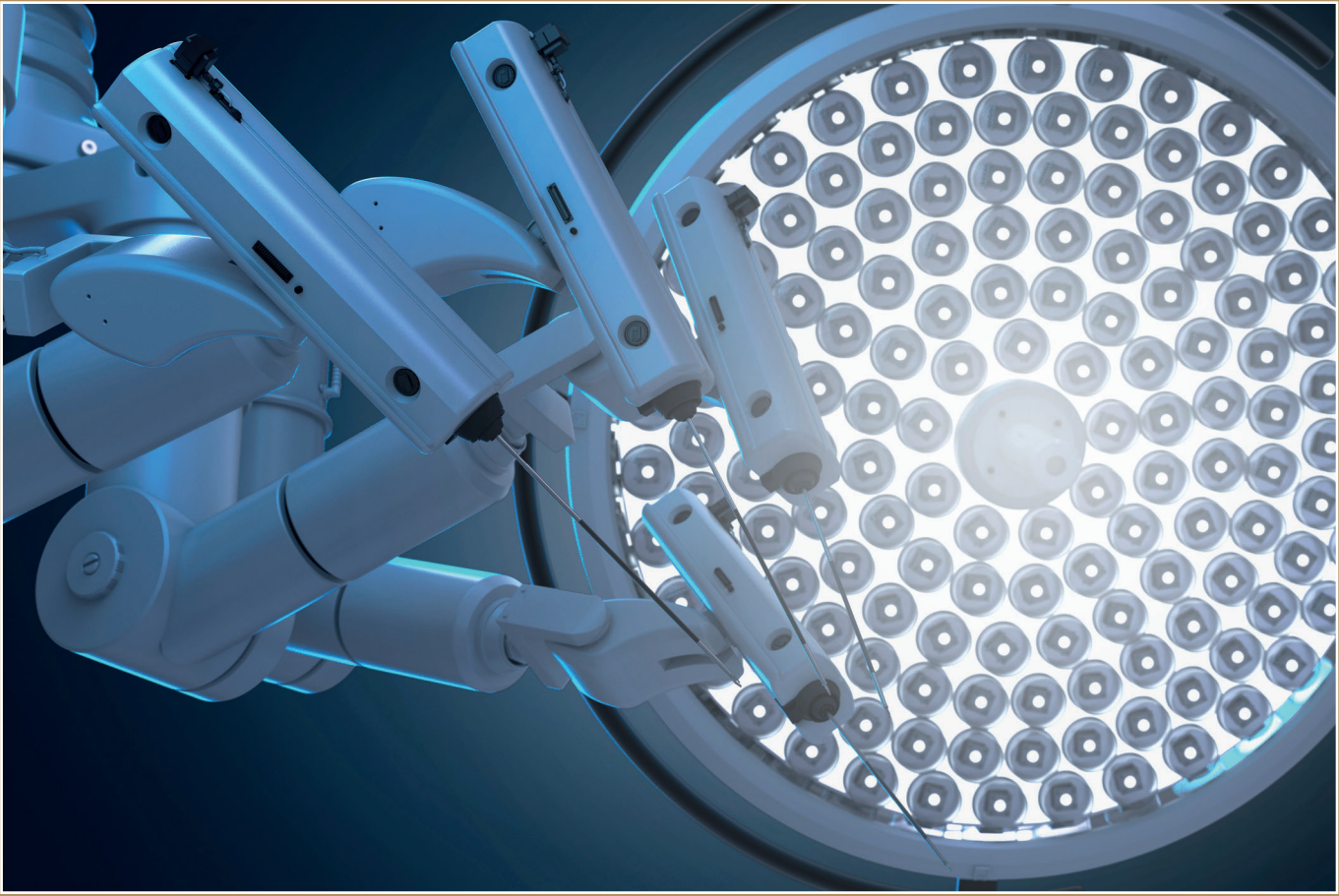
Blood supply and lymphatics. Lower extremity compartment syndrome is a rare, but serious complication of positioning (lithotomy position) that occurs from inadequate perfusion of the lower extremity. The resulting tissue ischemia, edema, and muscle breakdown increase facial compartmental pressure. Recommendations include periodically lowering the legs of patients in lithotomy position during prolonged procedures to promote perfusion.

Compartment syndrome presents as swelling, restricted movement, lack of sensation, tightness, and severe pain. In extreme cases there is an absence of an extremity pulse. Patients with compartment syndrome often report pain that is not relieved by analgesics. It is an acute medical emergency that most often requires urgent surgical treatment to minimize the risk for long-term morbidity or potential mortality.[10]

Ocular. Perioperative eye injuries are more rare than other intraoperative injuries; however, when they occur, they often lead to significant discomfort and anxiety for patients. Patient-related risk factors preoperative anemia, hypertension, peripheral vascular disease, coronary artery disease, diabetes, and obesity. Procedure-related risk factors include spinal surgery, cardiac surgery, head-neck surgery, hip and femur surgeries, procedures longer than 6 hours, prone or Trendelenburg position, and significant blood loss. Anesthetic-related risk factors include limited intravascular fluid administration or excessive crystalloid administration. Evidence of ocular injury is demonstrated in pupillary reactivity, light sensitivity, visual field defects and if the patient reports of blurred, distorted, or painful vision following surgery.[10]

Obesity. Special positioning needs and equipment for patients who are obese should be considered in order to provide the safest possible environment of care.[10] Obesity is a risk factor for positioning injury for several reasons:

- a heavier patient may not adequately fit on the surface of the OR bed;
- additional strain may be placed on the safety strap that holds them in place, thereby increasing the risk for strap-related skin injuries;
- surgeons might request tilting of the OR bed surface to the side in order to facilitate access to a surgical site in the abdomen, which could shift a significant amount of body weight onto the pelvic bones causing ulcerations in unexpected areas;
- potential for limbs falling off the table underneath the drapes and undiscovered until the drapes are removed.



ROBOT-ASSISTED SURGERY

Minimally invasive robot-assisted surgery offers many advantages over a traditional open surgery; however, this surgical approach also presents a particular set of risks[12] and new surgical positioning considerations that require special attention to ensure patient safety.[12,13] Robotic surgeries were introduced in the 1980s and used for a range of procedures. Over subsequent decades perioperative personnel have encountered challenges with safely securing and positioning the patient in extreme positions and monitoring for intraoperative injury. For example, patients placed in steep Trendelenburg (commonly used for robotic pelvic surgical procedures) were found to require intraoperative monitoring of intracranial pressure to prevent cerebral edema.[14,15] Patients sliding on the OR table has also become recognized as a serious patient positioning risk as the robot is not capable of adjusting to variations in the patient's position during surgery. When a patient slides, even slightly, the robotic arms, instruments, and trocars maintain their fixed location as programmed. Ultimately, they become the primary restraint for the patient (often referred to as "the meat hook" restraint). The literature suggests that patient injuries from sliding on the table during robotic procedures can present as severe and prolonged post-op pain, bruising, or even necrosis at the primary port sites.[16]

KNOWLEDGE CHECK

Which perioperative injuries are more rare than other intraoperative injuries?

A. Muscles and joints

B. Nerves

C. Blood supply

D. Ocular

[Click Here for Answer]

REFLECTING ON PRACTICE

In regard to safe patient positioning, do you think that your perioperative team has a good understanding of:

- the goals of patient positioning;
- performing an assessment to determine how goals can be met;
- planning for the needs of the patient and surgical team to promote efficient and effective transfers and positioning;
- collaborating with team members to plan positioning;
- completing safety checks to verify equipment is functional;
- documenting positions and patient-specific care that; and
- evaluating the outcomes of patient positioning.

High Risk Positions

The perioperative nurse has a duty to the patient to be the patient's advocate during a surgical procedure when the patient is unable to move themselves, feel pain or discomfort, or reposition themselves due to anesthetic effect.

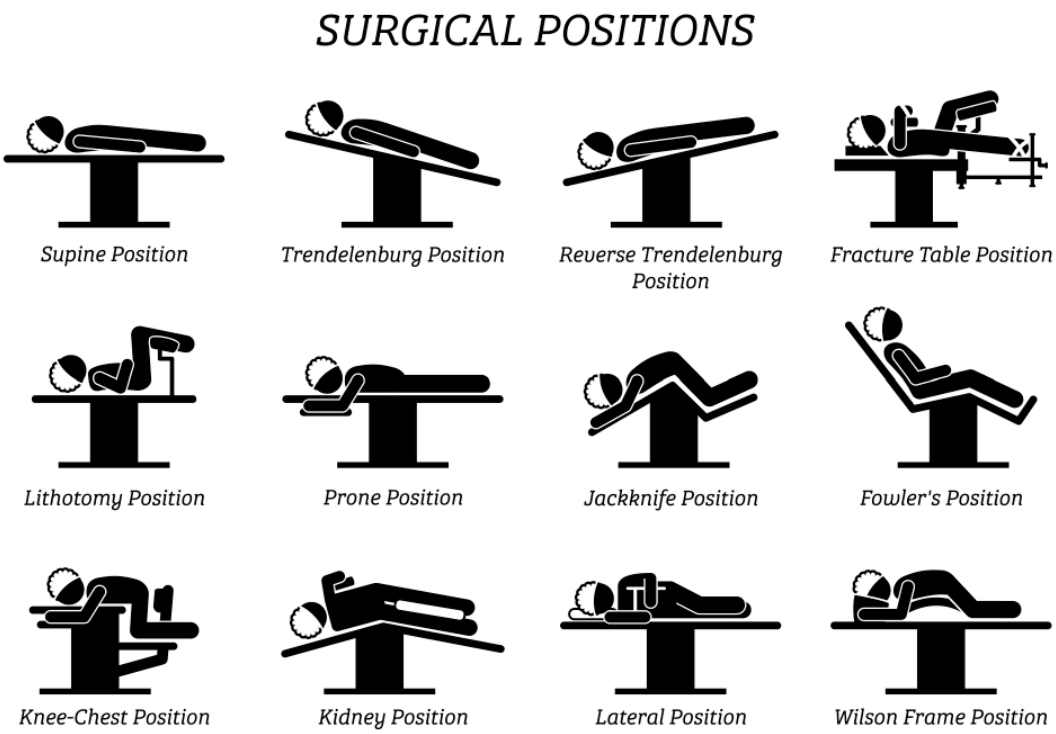
Research has identified specific surgical positions that pose a high risk of injury and therefore require special attention for planning and implementing specific supportive devices to protect the patient from injury. The following outlines specific patient safety risks associated with common high-risk positions.

Steep Trendelenburg

Trendelenburg is a position that is generally used for lower abdominal, colorectal, gynecology and genitourinary surgeries, and central venous catheter placement.[2] The patient's arms should be tucked at their sides and the patient must be secured to avoid sliding on the OR table.[10] In steep Trendelenburg, the patient is placed at a 30- to 40-degree angle in a head-down position. This type of Trendelenburg is most often used for robotic pelvic procedures. Trendelenburg position should be avoided for extremely obese patients.

Steep Trendelenburg Position

Risks to a patient while in this position include diminished lung capacity, diminished tidal volume and pulmonary compliance, sliding and shearing, altered pulmonary function, airway edema, increased intracranial and intraocular pressure, and nerve injury.[10] Hemodynamic changes are usually temporary and most hemodynamic variables return to baseline within minutes. Respiratory changes generally result from upward displacement of abdominal contents into the diaphragm, which decreases functional residual capacity and respiratory compliance, requiring higher airway pressures to maintain ventilation. Gravitational changes from a prolonged



head-down positioning can lead to increased intracranial and intraocular pressure, swelling of the face, larynx and tongue, which increases the risk for airway obstruction. Sliding and shifting is a risk and there have even been reports of patients falling off the OR table while not correctly secured in this position, with one patient sustaining permanent paralysis caused by the fall.[17] This can be prevented with the use of shoulder braces being cautious to not add undue pressure or stretching to the brachial plexus.[10]

Lithotomy

In Lithotomy position, the patient can be placed in either a boot-style or stirrup-style leg position. Modifications to this type of position include low, standard, high, exaggerated, or hemi.[2] This position is typically used for gynecology, colorectal, urology, perineal, or pelvis procedures. The risks posed to a patient in a Lithotomy position for a procedure include fractures, nerve injuries, hip dislocation, muscle injuries, pressure injuries, and diminished lung capacity. While placing a patient in this position, perioperative personnel should avoid hyperabduction of the patient's hips and leaning against their inner thighs.[10] Excessive flexion that exceeds 80 to 90 degrees or abduction that exceeds 30 to 45 degrees can stress a patient's hip joints, resulting in femoral, sciatic, obturator, or common peroneal neuropathy. The patient's hands and fingers could be injured as the bottom of the OR bed is moved or reattached.[18] Stirrups used on a patient in this position should disperse support and pressure across broad areas.[10]

The patient's legs should be raised and lowered simultaneously to prevent spinal torsion and muscular injury; prolonged procedure time increases the risk for lower extremity compartment syndrome secondary to inadequate perfusion; recommendations include periodically lowering the extremities throughout prolonged procedures. Lower extremity padding should be used to prevent nerve compression against leg positioners, as peroneal nerve injury commonly occurs where the peroneal nerve wraps around the head of the fibula, which is the part of the body that rests against the positioners.[18] Hemodynamic changes include the increased venous return and transient increases in preload and cardiac output. Respiratory changes result from cephalad displacement of abdominal contents resulting in decreased lung compliance, functional residual capacity, and tidal volume.

Prone

In the prone position, the patient is placed face-down with their head in a neutral position without excessive flexion, extension or rotation. Prone position is often used for spine and neck, neuro, colorectal, vascular, and tendon surgeries. This position provides access to the dorsal region of the patient's body and has several variations, including jack-knife/Kraske (sacral, rectal, or perineal procedures) and the knee-chest position (spinal procedures).[10] Respiratory changes in this position can cause alveolar recruitment (opening) and increased oxygenation without affecting cardiac output, which makes it a useful position in severely hypoxemic patients in early acute respiratory distress syndrome (ARDS).[19]

At a minimum, four members of the perioperative team should be available when turning a patient prone. A face positioner with openings for the eyes, nose, and chin should be used when the patient's head is in midline to support the forehead, malar regions (face), ears, and breast – there should be special care given to avoid undue pressure on the eyes as perioperative vision loss is an avoidable complication of the prone position. Foam or gel positioners may be used for spinal procedures.[10]

Risks associated with the prone position include increased abdominal pressures, bleeding, compartment syndrome, nerve injuries, cardiovascular compromise, ocular injuries, and venous air embolism.[20] There is also risk of dislodgement of monitors and tubes, which can be minimized by disconnecting as many monitors, lines, and catheters as possible prior to turning the patient.

Prone Position

Fowler's/Beach Chair

Fowler's position is a seated position typically used for neuro and shoulder surgeries. The beach chair position is a semi-sitting position (also referred to as semi-Fowler's) that often used for nasal surgeries, abdominoplasty and breast surgeries. This position elevates the head, neck and torso with hips and knees flexed to access the shoulder, posterior cervical spine, or posterior or lateral head.[10] Beach chair results in increased oxygenation by maximizing chest expansion, minimizing abdominal muscular tension and the impact of gravity on the chest wall, which makes it a useful position for patients in mild to moderate respiratory distress.

Perioperative personnel should minimize the degree of the patient's head elevation as much as possible and maintain the head in a neutral position. The patient's arms should be flexed and secured across the body, the buttocks should be padded and the knees flexed 30- to 45-degrees.

In the beach chair position, the patient is at an increased risk for air embolism, skin injury from shearing and sliding, compression of the sciatic nerve and DVT forming in the patient's lower extremities from poor venous return. Neck flexion can lead to nerve injuries affecting the glossopharyngeal, vagus, and hypoglossal nerves. There is also increased pressure risk in their scapulae, sacrum, coccyx, ischium, back of knees, and heels.[10]

Lateral

A patient may be placed in the lateral position for ENT, orthopedic, colorectal, kidney, and some kidney and thoracic surgeries.[18] The patient is placed on the non-operative side to provide exposure to the opposite side. A pillow or head positioner should be placed under their head with the depended ear assessed after positioning. The patient's physiologic spinal and neck alignment should be maintained, and a safety restraint should secure the patient's hips. A pressure-reducing OR mattress or pad can be used when appropriate.

Risks to patients include pressure to boney prominences on the dependent side of the body (eg, ears, shoulders, ribs, hips, knees, and ankles) and brachial plexus injury, venous pooling, diminished lung capacity, and DVT.[10] A high risk of pressure injury is possible for any area on the non-operative side of the body. Incorrect placement of the arms can increase the risk of stretching and compression injuries and incorrect placement of the axillary roll can injure the long thoracic nerve. If the patient restraint strap is not secure or placed incorrectly, there could be risk of the patient tilting and falling from the table. Prolonged surgery in this position increases the risk of muscle compression that can lead to compartment syndrome or rhabdomyolysis.[21] The patient's head and neck should be maintained in a neutral position and the upper extremities should be placed in front of the patient with neither arm abducted more than 90-degrees to mitigate lateral rotation and stretch injury to the brachial plexus. Personnel should be careful to avoid folding or rolling the dependent ear or placing undue external pressure on the dependent eye. An axillary roll should be placed below

Fowler's/Beach Chair Position

Lateral Position

the axilla to inhibit compression of the brachial plexus and axillary vascular structures. Placing padding between the knees and below the dependent knee averts excessive external pressure over bony prominences and the dependent lower extremity can be slightly flexed to avoid stretch or compression of the lower extremity nerves.[10] The dependent upper extremity is flexed at the shoulder and slightly flexed at the elbow and secured on a padded arm board with padding under bony prominences; invasive arterial monitoring should be placed in the dependent arm to better detect compression of the axillary vascular structures. The non-dependent upper extremity is flexed at the shoulder and slightly flexed at the elbow and often secured with a suspended armrest with care not to abduct the arm more than 90 degrees and to pad the bony prominences.

Body Mechanics and Ergonomics

Evidence-based research shows that safe patient handling interventions can reduce overexertion injuries considerably by replacing manual patient handling with safer methods guided by the principles of ergonomics. Ergonomics is the design of work tasks to accommodate the capabilities of workers. With regard to patient handling, it involves using equipment and safety procedures to lift and move patients so that health care personnel can avoid using manual exertions and thereby reduce risk of injury. Likewise, patient handling ergonomics endeavors maximize safety and comfort for patients during handling.[22]

An ergonomic approach to patient positioning can reduce musculoskeletal and other injuries in perioperative personnel.[23] These injuries generally result from the long-term cumulative physical effort of moving patients as well as acute effects, which result from incidents during transfers. They may also develop when a one-time task is performed that requires the body to perform above its capacity. Musculoskeletal injuries include damage to muscles, ligaments, tendons, nerves, bursae, joints, and intervertebral discs. Symptoms of damage can include:

- pain and/or swelling
- numbness, burning, or tingling sensations
- loss of mobility

"Ergonomic approaches to patient positioning can reduce musculoskeletal and other injuries to perioperative personnel.[22]"

Potential risk factors include excessive reaching, pushing or pulling, bending, excessive load and awkward posture or positions. Location of risk or impact of the task can include the back, shoulders, hands, and knees. Perioperative personnel should consider factors that affect lifting (eg, weight of load, horizontal distance from body, twisting, frequency, etc.) and know what type of assistive devices are available, where they are located, and commit to using them.[23]

Interdisciplinary Collaboration, Communication, and Workflow

Team collaboration with effective communication is essential to ensure safe positioning is planned, executed, and monitored throughout the patient's surgical experience. The substance of collaboration is how healthcare professionals use teamwork to contribute toward goals, work together, and demonstrate reliability to one another. When perioperative professionals value collaborative relationships, they can then excel at their work and deliver high value patient care.[24] In many cases, the patient can assist in positioning prior to induction of anesthesia; however, once under general anesthesia, the perioperative team is responsible for carefully moving and positioning the patient. As mentioned previously in the text, careful positioning:[2]

- maintains body alignment;
- supports respiratory and circulatory function;
- safeguards skin and neuromuscular integrity;
- permits optimum ventilation by maintaining a patent airway and avoiding constriction or pressure on the chest;
- prevents poor perfusion due to elevation of extremities (eg, in lithotomy position);
- protects the patient's fingers, toes and genitalia;
- maintains adequate circulation;
- protects muscles, nerves and bony prominences from pressure injury;
- permits access to intravenous (IV) sites and other anesthesia support devices and monitoring equipment; and
- maintains patient dignity, comfort, and safety by preventing unnecessary exposure.

Preventing injuries is a collaborative effort that includes preoperative assessment to evaluate patient-specific needs in regards to positioning, equipment, and devices as well as application of the principles of safe patient positioning. Although the surgical procedure generally dictates the patient's position, perioperative nurses, surgical technologists, surgeons, and anesthesia providers must work together to achieve the goal of safe positioning. A lack of appropriate positioning equipment, competencies, and availability of positioning equipment has been found to increase the risk for positioning injuries to occur.[25] Therefore, advance planning for patient-specific positioning injury risk factors should be discussed and assessed as a team so that an effective positioning plan is in place for every patient prior to the procedure.[26]

Planning to Position the Patient

To ensure patient safety, procedures must be properly planned, and preoperative patient optimization can help ensure safety and efficiency. Advanced planning is crucial to achieving the goals of surgical positioning, which cannot be met without knowledge of the patient's history and specific surgical needs. The first step in planning is to be aware of procedure-specific factors such as:[10]

- the type of procedure,
- projected length and anticipated position,
- surgical exposure required, the anesthesia professional's access to the patient,
- positioning changes required during surgery, and
- positioning devices required.

Next, the team should perform a preoperative assessment to identify if the patients is at high risk of developing a positioning injury and special considerations that may necessitate additional precautions to be taken.[10] The parameters of the preoperative assessment should include, but are not limited to, the patient's age; height; weight and body mass index (BMI); skin condition; nutritional status; mental status (ie, confusion, history of falls or syncope); allergies; preexisting conditions; physical or mobility limitation; and presence of prosthetics, corrective devices, implanted devices, or external devices (eg, catheters, drains, orthopedic immobilizers)[10]; as well as jewelry or hair accessories and prosthetics or corrective devices.[10] Special precautions should be taken for patients who are at risk for falling. All of these pertinent patient factors may impact physiologic reactions to anesthesia that require special positioning consideration and all findings during the preoperative assessment should be clearly documented according to facility policy. During the advanced planning assessment, the perioperative team should also be aware of comorbidities in obese patients that increase their risk for positioning injuries and complications, such as diabetes, hypertension, hyperlipidemia, cardiac disease, sleep apnea, and osteoarthritis. The perioperative personnel should also anticipate and identify patient needs for safe positioning, to include having patient-specific positioning requirements (eg, positioning devices, equipment, appropriate number of personnel in the room) available in the room prior to the patient's arrival. Finally, once the patients risk factors have been identified, the risk and planned interventions should be communicated to the surgical team during the time-out.

KNOWLEDGE CHECK

Careful positioning _____.

A. protects the patient's fingers, toes and genitalia

B. permits access to intravenous (IV) sites and other anesthesia support devices and monitoring equipment

C. prevents poor perfusion due to elevation of extremities (eg, in lithotomy position)

D. all of the above

[Click Here for Answer]

DOCUMENTATION

Accurate documentation of care provided, type of positioning, and use of positioning devices should be reflected in the patient's intraoperative record.[10] This includes, but is not limited to:

- THE POSITION TO BE USED DURING THE PROCEDURE;
- TYPE OF POSITIONING DEVICES NEEDED;
- THE GOALS OF PATIENT POSITIONING;
- PERFORMING AN ASSESSMENT TO DETERMINE HOW GOALS CAN BE MET;
- PLANNING FOR THE NEEDS OF THE PATIENT AND SURGICAL TEAM TO PROMOTE EFFICIENT AND EFFECTIVE TRANSFERS AND POSITIONING;
- COLLABORATING WITH TEAM MEMBERS TO PLAN POSITIONING;
- COMPLETING SAFETY CHECKS TO VERIFY EQUIPMENT IS FUNCTIONAL;
- DOCUMENTING POSITIONS AND PATIENT-SPECIFIC CARE THAT; AND
- EVALUATING THE OUTCOMES OF PATIENT POSITIONING.

Documenting all patient-related factors that can influence an increased risk of positioning injury is not just important for the information of perioperative personnel at each stage of surgical care, but also for other members of the care team (eg, radiology, lab) who may provide care to the patient. For example, preoperative planning to provide additional padding to redistribute pressure and communicating that to other departments can provide vital information to adjust the plan of care to prevent intraoperative positioning injury.[27]

Risk Assessment Tools

Several steps can be taken to decrease the incidence of positioning injuries among surgical patients. It is important that all members of the perioperative team are familiar with evidence-based screening tools and how to use them to evaluate patient risk, resources already in place, and any resources that need to be added. As part of the patient's health record, all risk scores for any tool used should be communicated to each perioperative phase of care and inpatient unit, as applicable, as part of care coordination.

The Scott Triggers Tool (Figure A) identifies high-risk patients preoperatively by evaluating four evidence-based predictors of perioperative pressure injury: age, BMI, ASA physical status classification score, and estimated time of surgery.[28] The tool prompts perioperative personnel to implement additional interventions to reduce the patient's risk. It provides rapid, real-time identification of potential problems and enables timely, productive intervention at the patient level.

The CMUNRO SCALE (Figure A) is a pressure risk assessment scale evaluates patient risk factors for pressure injury development by evaluating three phases of care: preoperative, intraoperative, and postoperative. It guides perioperative nurses and other perioperative professionals to methodically perform a pressure injury risk assessment. The CMUNRO tool displays all of the risk factors included in the Munro Scale[29] and in the same progression of the surgical experience with a succinct approach that supports personnel in collaborative communicating and documenting patient risk. Each assessment phase of the Munro Scale results in a risk score of low, medium or high and a cumulative score is assigned. The patient's level of risk may change throughout the perioperative period based on accumulation of risk factors.[29]

FIGURE A – PRESSURE INJURY RISK ASSESSMENT TOOLS

Tool	CMUNRO Scale	Scott Triggers Tool
Indicators	Preoperative, intraoperative and postoperative indicators	• Age older than 62 years • Serum albumin level <3.5 g/L or BMI <19 kg/m^2 or >40 kg/m^2 • ASA class of III or higher • Estimated procedure time longer than 180 minutes
Scoring	Each indicator is scored as low, medium, or high for each phase of care. Cumulative score reflects patient's risk for pressure injury.	Each indicator is considered a trigger. Patients with 2 or more triggers are considered high risk for pressure injury.
Patient Population	Developed specifically for perioperative patients.	Developed specifically for perioperative patients.

Prevention of Perioperative Pressure Injury Tool Kit. AORN. https://www.aorn.org/guidelines/clinical-resources/tool-kits/prevention-of-perioperative-pressure-injury-tool-kit. Accessed Jan. 1, 2022.

Device Selection

The perioperative team should identify and plan for appropriate positioning equipment and devices to be available prior to the procedure. This planning has the ability to not only protect the patient from potential positioning injuries, but it can also save time. Equipment needs should be checked for availability before the patient is transferred to the OR and also for proper function in order to prevent delays in the surgical procedure and minimize the risk for patient injuries. Safety checks of all equipment to be used should be completed well before the patient is transferred to the OR. Ideally, this should happen prior to the day of to ensure availability of positioning equipment that can be accommodated in the surgical space where the procedure will occur.[10]

General considerations for the safe use of positioning equipment, devices and material include:[10,30]

- positioning equipment, devices and materials should be inspected on a regular basis and maintained in good operating condition;
- equipment scheduled for use during a procedure should be checked before use to confirm that the surface is smooth and intact;
- personnel must demonstrate competency when using positioning equipment, devices and materials;
- personnel must know and comply with facility policies and procedures;
- personnel must review and be aware of manufacturers' instructions for use (IFU) for devices and equipment.

One factor that may be overlooked in safe patient positioning is the age and condition of the OR bed mattress; this is a general risk factor that can be assessed and addressed immediately. Research studies have found that standard 2-inch-thick foam pads covered with laminated vinyl may actually increase the risk of pressure injuries developing during surgery; moreover, pads that are 2 inches thick or less do not provide adequate support for heavier patients. Personnel should consider replacing standard OR bed pads with thicker coverings comprised of multiple layers of dense foam that is specifically designed to disperse load pressure across the surface area. Perioperative personnel should also be aware that additional layers of linen, padding or warming devices can interfere with the ability of the surface to redistribute pressure.[10]

Pressure-redistributing mattresses can also be used for patients at risk for developing pressure injuries.[33,34] Traditional mattresses in the OR are generally made of approximately one to two inches of foam, covered with a vinyl or nylon fabric; however, studies have shown that foam overlays or replacement pads, which represent the majority of OR bed mattresses, do not possess effective pressure-reduction capabilities. Studies that compared the pressure-reducing abilities of standard foam procedure bed mattresses to gel mattresses reported that gel mattresses are more effective.[34] A study found that polyether mattresses generate a lower capillary interface pressure when the patient was in the supine position than either gel or foam mattresses.[35] Another study reported that both foam and gel mattresses are effective for preventing skin changes, but viscoelastic overlays are effective for preventing both skin changes and pressure sore formation.[34,36]

Collaborating During Positioning to Prevent Positioning Hazards

During positioning the perioperative team should collaborate on which position, equipment and/or devices need to be used. This decision should be based the type of surgery, surgeon's preferences, and positioning risk factors identified during the preoperative patient assessment.

Placing the Patient in the Desired Position

The position should provide optimal exposure, support correct placement of equipment and/or devices, and provide access for anesthesia and medication administration.[31,32] The patient should be in as comfortable a position as possible, before receiving anesthesia as an awkward position can place undue pressure on a body part. When stirrups or traction are used, they should not obstruct the vascular supply to any body part. The team should confirm that respirations are not impeded (ie, pressure of arms on the chest, a patient gown that constricts the neck or chest). Nerves must be protected from undue pressure. Shoulder braces must be padded adequately to prevent irreparable nerve injury, although they are not recommended by AORN for Trendelenburg position due to risk of nerve compression injuries.[10] Precautions for patient safety should be observed, particularly with patients who are elderly, thin, obese, or have a physical disability. The team should also check the OR table prior to transferring the patient to ensure it is locked and properly prepared for the patient with correct padded attachments. The correct number of personnel should be identified and available to move a patient. The surgical team should coordinate their actions when moving and positioning the patient and maintain body mechanics and ergonomics to prevent injury. Patients should be moved slowly and gently, being mindful of tubes, drains, lines, and monitors.[10] Once on the OR table, the patient should not be left alone - patients are often under the effects of preoperative medications, may have a history of falls or attempt to get up and therefore the risk for injury is substantial. The team should communicate who will be in the OR with the patient prior to the sterile surgical team beginning the procedure (usually the circulating person and anesthesia care provider).

Use of Positioning Devices

The manufacturer's IFU should provide evidence of the efficacy of the device and that the product provides proper support and reduces pressure and protects the body as expected. Therefore, the team should follow positioning device IFU and ensure OR beds, equipment, and devices have the weight and size capacity to safely position and support the patient.[10]

During positioning, a pillow or contoured foam or gel headrest can be used to position the patient's head and protect the ears and nerves of the face. Pillows or foam or gel pads can be used to support and elevate body parts. Eye pads may be used to protect the eyes and keep them closed. Arm boards support the patient's arms and provides the anesthesia provider access to peripheral IV lines and monitoring equipment. Shoulder braces have been used to prevent sliding in Trendelenburg position, but are no longer recommended by AORN because they cause compression over the acromion injuring the brachial plexus, which is exacerbated by the muscle-relaxing, joint-mobilizing effects of general anesthesia.[10] Kidney braces elevate the flank in lateral position. Foot boards can keep patients from sliding downward in reverse Trendelenburg position. Stirrups are used to elevate the legs off of the surface of the OR table and the patient's legs should be lifted into and lowered simultaneously and slowly to avoided joint and nerve injury. Padding should be added

to protect the legs from undue presser on nerves and/or skin. Beanbag positioners mold around the patient to keep them in place, preserves skin integrity, and wicks moisture. A laminectomy frame or chest roll supports the body in prone position while also allowing adequate excursion of the chest for effective respiration.

Physiologic Effects of Anesthesia and Anatomical Structures of the Body

Collaboration during positioning can mitigate position-related injuries, in particularly when adequate personnel collaborate to facilitate the maneuver at the beginning and end of the procedure.

As stated previously, all positions used during surgery have the potential to cause cardiovascular and pulmonary changes and these risks should be discussed and acknowledged as a team during positioning. General and neuraxial anesthesia can impact normal compensatory mechanisms that maintain cardiovascular stability and can trigger changes in ventilation and perfusion resulting in hypoxemia. In addition, compression of tissue or vascular structures can cause regional ischemia. Therefore, the team should be able to identify and talk through the physiologic effects of anesthesia and the anatomical structures of the patient's body (eg, skin, nerve, vascular, and joint structures) that can be vulnerable to compression, stretching, pressure, and other effects of positioning strain during surgery according to the specific procedure and patient risk assessment.[37]

When a patient will be placed in steep Trendelenburg, the team should discuss understanding that this position further increases translocation of blood to the central compartment of the heart. Intracranial and ocular pressure increase in in this position secondary to decreased cerebral venous drainage. Decreases in pulmonary compliance and functional residual and vital capacity also occur and peak airway pressures during mechanical ventilation should also be noted. If the patient will have a prolonged surgery, the perioperative team should be prepared for the possibility of significant facial and upper airway edema.[38]

When lithotomy is the position of choice for the patient's procedure, the team should be knowledgeable that the leg elevation redistributes pooled lower limb blood, which may lead to volume overload in susceptible patients. It is important to assess any limitation of joint movement prior to induction of anesthesia as this may indicate important constraints on possible positioning. It is good practice to flex both legs at the hips and knees simultaneously. Extreme flexion of the hip joints can cause neural damage by stretch (eg, sciatic and obturator nerves) or by direct pressure (compression of the femoral nerve as it is passes under the inguinal ligament). Distally, the common peroneal nerve and saphenous nerve are especially vulnerable to compression injury as they wind around the neck of the fibula and medial tibial condyle. Calf compression is common in this position and predisposes to venous thromboembolism and compartment syndrome. The etiology of compartment syndrome is likely a decrease in perfusion pressure caused by the weight of extremities against the supportive devices, reduction in compartment capacity, and elevation of the lower limb above the heart. Finally, when resting the arms by the side of the patient, the team should be aware not to crush fingers when the leg section of the table is replaced or elevated at the end of the procedure.[39,40]

Collaborate during positioning to mitigate position-related injuries."

When placing a patient in prone position, the team should know that many of the physiological changes that occur in this position can be minimized by careful positioning that averts pressure on the patient's abdomen. The consequences of a high intra-abdominal pressure are inferior vena cava compression, reduced venous return, and poor cardiac output. Associated pulmonary problems are caused by an increase in transdiaphragmatic pressure (TDP) leading to reduced thoracic compliance. The team should work together to ensure

that the patient's head and neck are carefully positioned to prevent excess pressure on the nose and eyes – these body parts are at particular risk as small movements are potentially hazardous, even if the initial position appears adequate. The final position of the upper limb should maintain a small degree of anterior flexion and then be abducted and externally rotated to <90° in both upper limbs simultaneously. The brachial plexus is at risk; therefore, care should be taken to ensure that the chest support is not impinging upon the axilla. Forearm supports/pads should be used to prevent direct compression of the ulnar nerve in the cubital tunnel and indirect compression of the axillary neurovascular bundle by axial pressure from the humerus. The dorsum of the foot as well as knees, pelvic area, breasts, axilla, elbows, and face are all at risk of pressure necrosis in this position, so the team should collaborate to ensure that all of these areas are properly supported and padded throughout the procedure.[39,40]

When the patient is in the beach chair position, the team should consider that the cardiovascular system is primarily affected by venous pooling, which can lead to resistant hypotension. Excessive neck flexion or extension may also be associated with obstruction of the neck veins. A noteworthy complication is venous air embolism; the pathophysiology being a combination of position related subatmospheric venous pressure and the non-collapsible nature of the dural sinuses.[39,40]

The lateral position is associated with the greatest number of ocular complications among the other common surgical positions.[40] These injuries are primarily corneal abrasions but occur in equal frequency in the dependent and non-dependent eyes. The brachial plexus is at risk if the head and neck do not have sufficient lateral support. An axillary roll traditionally supports the thorax, and the perioperative team should be aware that inadequate placement can cause the neurovascular bundle to be compressed in the axilla. Padding should be placed between the legs to prevent damage to both common peroneal and saphenous nerve.[39,40]

KNOWLEDGE CHECK

Which position is associated with the greatest number of ocular complications among other common surgical positions?

A. Lateral

B. Beach Chair

C. Prone

D. Steep Trendelenburg

[Click Here for Answer]

Postprocedure Debrief and Handover Communication

A postoperative patient assessment should be conducted to identify patient injury caused by intraoperative positioning.[32] The perioperative nurse should use their knowledge of pressure points, intraoperative factors, and locations of where safety restraints, adhesives, monitoring devices, positioning equipment or devices, and other items may present a risk for patient injury during the procedure. For example, a retrospective observational study of 2,695 surgical patients found that intraoperative administration of blood products was highly associated with pressure injuries,41 which is information that must be communicated amongst the team when applicable.

A debriefing or handover communication following a surgical procedure is a process where the perioperative team recaps the surgery and discusses team performance in a constructive and supportive manner. Prior to transfer of care, the team should take this opportunity to go over what went well, identify areas for improvement, and review any key concerns for the recovery and management of the patient.[42] At a high level, this communication should include at minimum:[10]

- areas of the patient's body that should be assessed and monitored for potential injury;
- events during the intraoperative period that may have contributed to a position-related injury; and
- the position of the patient during the procedure

All perioperative team members should reach consensus after positioning to confirm the positioning actions taken.[43] Any concerns with a potential for injury should be communicated in writing and verbally during the handover communication to the postoperative care team. If injury has occurred, changing the patient's position following the procedure can reduce pressure on high-risk areas. Routine monitoring of those high-risk areas can aide with early recognition and treatment.[10]

DEVELOPING GUIDANCE FOR SAFE POSITIONING

Evidence-based guidance for safe patient positioning has evolved as a natural progression of addressing and mitigating postoperative injuries that were found to be the result of surgical position. However, many positioning injuries can be difficult to link back to a surgery because the effects of injury may not develop until hours or days following the procedure. Over the years, quality improvement activities and research have helped perioperative team members better understand how positioning injuries occur. For example, pressure injury is a common and visible positioning injury known to develop during a surgical procedure that has led to a wealth of research aimed at preventing positioning injury, especially after the Centers for Medicare & Medicaid services classified pressure injury as a Never Event in 2008.[44] In 2009, an article was published reviewed practices regarding pressure injury prevention efforts for surgical patients and emphasized the importance of extrinsic (procedure-related) and intrinsic (patient-related) factors that can increase the risk for positioning injury and also underscored the importance of advanced preoperative planning for the use of pressure redistribution support surfaces.[45]

The extensive literature of risk factors associated with pressure injuries has resulted in advanced tools to guide risk assessments during positioning. Dr. Cassendra Munro, a perioperative nurse and creator of the Munro Pressure Injury Assessment Scale for Perioperative Patients©, is credited with using existing theoretical framework to develop an enhanced perioperative pressure injury risk-assessment (see Figure A). She used findings from an extensive review of the literature to identify key risk factors. During the study, the scale, demographic questionnaire, and evaluation form was distributed to nurses and anesthesiologists to obtain expert opinion to further the design of the scale. The results indicated that diabetes should be included as a risk factor category and that preexisting skin ulcerations, breakdowns, and conditions should be addressed within the scale. The participants unanimously agreed that moisture is an important factor to assess.[46]

Beyond pressure concerns impacting the patient's skin and deep tissue, a greater understanding of the physiologic changes a patient experiences while under anesthesia has helped to better understand how anatomy can be protected.[11] A wealth of research has indicated the permanent peripheral injury risk associated with incorrectly positioning a patient's arms or legs. Special positioning devices such as stirrups that prevent medial leg drop have been developed to prevent peripheral nerve injury during surgery.[47] High impact evidence from recent research has been used to shape evidence-based guidance for safe positioning from professional associations, such as Association of periOperative Registered Nurses (AORN) "Guideline for positioning the patient."[10]

"A wealth of research has indicated the permanent peripheral injury risk associated with incorrectly positioning a patient's arms or legs."

As perioperative team members continue to learn about the causes of positioning injury and the results, the same guidance they look to for prevention has influenced a boon of medical devices aimed at positioning injury prevention. Several positioning devices represent great examples of technologies that have followed the evidence to support safe positioning. It is also well reported in the literature that the surface a patient is placed on can impact the potential for injury, especially for complex procedures such as spinal surgery.[48] Patient BMI is also a factor that influences how the procedural table/surface can best support patient positioning Therefore, surgical tables have been designed with this safety in mind, such as tables designed for specific positions, such as if the patient needs to be positioned from supine to prone during the procedure.

Perioperative departments should use evidence-based guidance to develop policies, procedures, protocols, and tools to reinforce best practices related to positioning surgical patients. When patients have been administered anesthesia, their ability for to communicate pain and pressure to the perioperative team is impeded or eliminated. As a result, the team members become responsible for the patient to ensure positioning has been conducted in a safe manner and the integumentary, musculoskeletal, respiratory, and circulatory system functions have been preserved. These policies and procedures should also address proper body mechanics and ergonomics. Ideally, this should happen by establishing a formal safe patient handling and movement (SPHM) program where a comprehensive assessment of SPHM needs, current patient and equipment handling technology and adverse events data is used to develop written goals, objectives, and a plan for ongoing evaluation, compliance, and quality improvement.

SAFE PATIENT POSITIONING BASED ON AORN GUIDANCE

Understanding best practices associated with specific positions and devices can support perioperative team members with proper positioning. The following represents high-level best practices and device selection considerations for common surgical positions.

Steep Trendelenburg	Lithotomy	Prone	Beach Chair	Lateral
• Minimize the degree of as much as possible • Place the patient in this position for the shortest time possible • Reposition patients into the supine or reverse Trendelenburg position at established intervals during the procedure (if possible) • Implement measures to prevent sliding • After positioning the anesthesia professional should check the airway maintenance device and make any corrective actions • Do not use shoulder braces or circumferential wrist restraints • Do not use this position for patients who are extremely obese (if possible)	• Place the patient in this position for the shortest time possible • Do not place the safety restraint over the chest or abdomen • Position the buttocks even with the lower break of the procedure bed that securely supports the sacrum on the bed surface • Position the hips in a manner that prevents excessive flexion, rotation, or abduction • Place leg holders at an even height • Support the legs over the largest surface area of the leg • Place the heels in the lowest position • Do not allow the legs to rest against the leg holder posts. • Place the legs into the leg holders slowly and simultaneously, with at least one person positioning each leg • Remove the legs from the leg holders in a two-step process • Graduated compression stockings and/or intermittent pneumatic compression devices may be used • Do not use the hemi-lithotomy position (if possible)	• Position patients in 5-degree to 10-degree reverse Trendelenburg (if possible) • Place the patient in this position for the shortest time possible • Position the head in a neutral position, without excessive flexion, extension, or rotation • Implement interventions to prevent direct pressure on the eyes • The anesthesia professional should assess the airway maintenance device after positioning, during the procedure, and after the patient is returned to the supine position • Position the arms safely and in accordance with the needs of the surgical team • Position the patient on two chest supports that extend from the clavicle to the iliac crest • Position the breasts, abdomen and genitals so they are free from torsion or pressure • Pad the knees • Elevate the toes off the bed by placing padding under the patient's shins so the shins are high enough to prevent pressure on the tips of the toes • Assess the pedal pulses after positioning in the knee-chest position and during the procedure	• Minimize the degree of head elevation as much as possible • Maintain the head in a neutral position without excessive flexion, extension or rotation. • Flex and secure the arms or nonoperative arm across the body • Pad the buttocks • Flex the knees 30 degrees • Prevent abdominal pannus from resting on thighs and verify placement and security of the safety restraint across the thighs • Sequential compression devices may be used • Do not use the sitting position for patients with ventriculoperitoneal shunts (if possible) • Be prepared to detect and implement interventions to manage AE events	• Place the patient in this position for the shortest time possible • Place a head positioner or pillow under the head • Support and secure the arms on two level and parallel arm boards, with one arm on each arm board, the upper arm above the lower arm, and both arms abducted less than 90 degrees • Place an axillary roll under the dependent thorax, distal to the axillary fold, at the level of the seventh to ninth rib • Maintain physiologic spinal alignment • Do not compress the breasts and abdomen or allow them to hang over the edge of the OR bed • Place a safety restraint across the hips • Flex the dependent leg at the hip and knee • Position the upper leg straight and support it with pillows between the legs • Minimize as much as possible the degree of bed flexion and the duration of kidney rest elevation used to provide additional exposure (eg, renal procedures, thoracic procedures)

Fleisch MC, Bremerich D, Schulte-Mattler W, Tannen A, Teichmann AT, Bader W, Balzer K, Renner SP, Römer T, Roth S, Schütz F. The prevention of positioning injuries during gynecologic operations. *Guideline of DGGG* (S1-Level, AWMF Registry No. 015/077, February 2015). Geburtshilfe und Frauenheilkunde. 2015;75(08):792-807. DOI: https://doi.org/10.1055/s-0035-1557776.

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Association of periOperative Registered Nurses. Guideline for positioning the patient. In: *Guidelines for Perioperative Practice*. Denver, CO: AORN, Inc. 2020:629-704.

The AORN "Guideline for positioning the patient"[10] recommends that the use of positioning devices is documented on the intraoperative record that includes:[10]

- the preoperative nursing assessment, including a description of the patient's overall skin condition upon arrival and at discharge from the OR suite;
- the type and location of equipment used for positioning;
- names and titles of personnel who assist in positioning the patient;
- the patient position as well as the new position a patient is repositioned into; and
- the post-operative nursing assessment for any injury related to the patient's position.

Personnel should be aware of the most recent findings in literature regarding positioning and the latest evidence-based positioning equipment that has advanced features for ease-of-use and patient safety. When using steep Trendelenburg or lithotomy positioning devices, personnel should choose products that are straight forward and easy to use correctly. The support surface should conform to the patient's entire surface, such as the complete supine anatomy for the steep Trendelenburg position to create a larger surface area to cradle the body firmly and securely. Positioners that have integral quick-release straps that enable the device to attach tightly to the rails of standard operating tables should be considered. Special positioners are available and should be used to accommodate larger patients. For prone position, personnel should select an OR table that has an intuitive user interface and convenient features such as central locking, rolling castors, and numbered H-brackets for improved communication. Radiolucency through the length of the table is a beneficial feature for complex procedures. Another benefit is the ability to reposition the patient from supine to prone and vice versa. For a sitting or beach chair position a basic OR table should be selected that can be easily modified for the specific position (sitting, reclined), including detachable table section, ease of mobility but with locking castors for safety and easy to use automated movement to safety raise the table to sitting/beach chair position. A lift-assist beach chair support surface that permits safe and easy repositioning should be considered. A lateral slide feature can be beneficial to enable the surgeon to move the patient closer to the edge of the OR table for increased surgical site access. The lateral position benefits from an OR table that can be easily modified for moving the patient to a lateral position. A table that provides easy mobility with locking castors for safety with a user-friendly movement capability to support the lateral-positioned patient is optimal. Select a lateral positioner that safely and comfortably holds a patient in a lateral position. Consider a device that includes a quick-release strap that allows it to attach securely to the rails of standard OR tables and has a secure valve that eliminates the need for continuous suction.

SUMMARY

Surgical positioning is a key factor of carrying out safe and efficient procedures. Positioning aims to provide the best anatomical exposure for surgery, although there are risks to patients and the team that result from common position used, because the anesthesia renders the patient unable to alert the team about any discomfort. Multiple factors should be considered when choosing the patient's position to ensure the patient's safety and perioperative personnel should know the various types of equipment and materials available to prevent injury.

In all phases of surgical care, collaborating with team members to plan, carryout and follow up on positioning needs, outcomes, and issues is vital. This requires an understanding of the goals of patient positioning and know how to determine how the goals can be met. Accurate pre-planning with other members of the perioperative team is especially important when using high-risk positions and should include precautions that safeguard both the patient and members of the perioperative team, to include ensuring that positioning devices are available and can be ready to use on the day of surgery. Ideally these devices should incorporate the latest evidence-based designs and precaution measures that are safe and easy to use. Early risk assessment, including the use of a combination of evidence-based validated risk assessment tools, skin assessment, and clinical judgment is crucial to confirm positioning injury risks. The team should then discuss all patient positioning injury risks identified in the assessment and confirm the plan to mitigate these risks ensuring the positioning device IFU is followed. During the procedure designated team members should conduct on-going assessment of the patients for signs of positioning injury, including to ensure sliding has not occurred and risks skin integrity or limbs moving out of safe position.

GLOSSARY

Body Mass Index (BMI): The weight-to-height ratio calculated by dividing weight (in kilograms) by height squared (meters).

Capillary Interface Pressure: The amount of pressure that is placed on the resting surface of the skin over a bony prominence; normal capillary interface pressure is 23 to 32 mm Hg.

Friction: The force of two objects or tissue surfaces rubbing against one another.

Lateral Position: Used during surgery requiring access to the thorax, retroperitoneum or hip with a patient lying on the nonoperative side and careful positioning of the extremities.

Lithotomy Position: Used during gynecologic, rectal and urologic surgery where the patient lays supine with legs abducted 30 to 45 degrees from midline with knees flexed and legs held supported with the foot of the bed lowered or removed to facilitate the procedure.

Positioning Devices/Equipment: Any device or piece of equipment used for positioning the patient and/or providing maximum anatomic exposure (ie, support for the head, arms, chest, iliac crest and lumbar area); pads for pressure points; securing devices (eg, safety belts, vacuum-pack positioning devices); OR table accessories (eg, headrest, overhead arm supports, stirrups, footboards); and specialty surgical tables (eg, fracture table).

Pressure: The force that is applied vertically or perpendicular to the surface of the skin and underlying tissue.

Pressure Injury: Localized damage to the skin and underlying soft tissue, typically over a bony prominence or related to a medical or other device. The injury can manifest as intact skin or an open ulcer and may be painful.

Prone Position: Used during surgery requiring access to the posterior fossa of the skull, posterior spine, buttocks or perirectal area, or lower extremities with the patient lying on his or her front with head, neck, and spine maintained in a neutral position; the patient is turned from supine to prone while maintaining the neutral position of the head, neck, and spine.

Supine Position: The most common position for surgery where the patient lays on their back with head, neck and spine in neutral positioning and arms either adducted alongside the patient or abducted to less than 90 degrees.

Trendelenburg Position: A variation of supine where the head of the bed is tilted down such that the pubic symphysis is the highest point of the trunk facilitates venous return and improves exposure during abdominal and laparoscopic surgeries.

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