A Comparison of the Lateral Decubitus and Beach-chair Positions for Shoulder Surgery: Advantages and Complications

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Review Article

A Comparison of the Lateral Decubitus and Beach-chair Positions for Shoulder Surgery: Advantages and Complications

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Abstract

Arthroscopic or open shoulder surgery can be performed using the lateral decubitus or beach-chair position. Advantages of the lateral decubitus position include better visualization and instrument access for certain procedures and decreased risk for cerebral hypoperfusion. Complications associated with this position include traction injuries, resulting in neurapraxia, thromboembolic events, difficulty with airway management, and the potential need to convert to an anterior open approach. One advantage of the beach-chair position is easier setup from a supine to upright position, which allows the surgeon the option to convert to an open procedure if necessary. Although rare, patients in this position may experience cerebral hypoperfusion and complications that range from cranial nerve injury to infarction. Other complications related to this position include cervical traction neurapraxia, blindness, and cardiac and embolic events. The surgeon must be cognizant of the complications associated with both positions and take extra care in the initial patient setup and coordination with the anesthesiologist to minimize the risk of complications and morbidity.

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Arthroscopic or open shoulder surgery can be performed with the patient in the beach-chair or lateral decubitus position. Burkhart et al[1] state in *The Cowboy's Companion* that "for the surgeon to become an advanced shoulder arthroscopist, he or she should use the lateral decubitus position exclusively." However, Wahl and Warren[2] state that they "exclusively use the beach-chair position for anterior and posterior shoulder procedures." Conversely, some surgeons advocate for the use of the beach-chair position for rotator cuff repair and the lateral position for instability procedures. There are advantages and disadvantages of both positions with respect to the visualization, access to certain areas of the shoulder, time for and ease of set up, accuracy of portal placement, and risk of morbidity. Regardless of the position used, however, improper setup can result in added complexity and technical difficulty when performing shoulder surgery.

History

In 1931, Burman[3] published the first report on arthroscopic evaluation of the shoulder in cadavers. Modern shoulder arthroscopy has been performed since the late 1970s, and many consider Lanny Johnson to be the father of shoulder arthroscopy in the United States.[4,5] In 1986, Johnson described the technique for arthroscopic subacromial decompression

(SAD). Subsequently, Ellman[6] published the first series with a detailed description of the SAD procedure and short-term follow-up results. In general, the lateral decubitus position seems to be the preferred method of most shoulder surgeons practicing on the west coast of the United States.

The beach-chair position, also referred to as the sitting, semi-sitting, or barbershop position, was first developed on the east coast of the United States in the early 1980s. Skyhar et al[7] described their experience with arthroscopic shoulder surgery performed in 50 patients in the beach-chair position and reported no complications (Figure 1). The authors noted the following advantages: "ease of setup, lack of brachial plexus strain, excellent intra-articular visualization for all types of arthroscopic shoulder procedures, and ease of conversion to the open approach if needed."[7] The authors developed this technique in an effort to decrease the incidence of brachial plexus traction injuries and allow precise arm positioning during different phases of shoulder surgery. Warren's influence may explain the predilection for the beach-chair position for shoulder arthroscopy on the East Coast, whereas the lateral decubitus seems to be favored on the West Coast.

Figure 1

A B

A and **B**, First published photographs of a patient in the beach-chair position. **A,** The patient is placed on a standard operating room table that is brought up to 60° into the sitting position. **B**, The shoulder is brought off the side of the table up to the medial border of the scapula to facilitate access for arthroscopy. (Reproduced with permission from Skyhar MJ, Altchek DW, Warren RF, Wickiewicz TL, O'Brien SJ: Shoulder arthroscopy with the patient in the beach-chair position. *Arthroscopy* 1988;4[4]:256-259.)

Beach-chair Setup

A conventional operating room table can be used in conjunction with a full body-length vacuum beanbag, or the upper portion of a table can be replaced with a padded articulating headrest (Figure 2, A). Several other commercially available seated positioners designed to attach to a regular table can be used, as well. The patient should be placed as close to the edge of the table as possible to provide an unobstructed view to the medial border of the scapular spine. The patient is transferred to the operating room table with all bony prominences well padded. When the patient is under anesthesia, the ulnar nerve and common peroneal nerve are the most commonly injured nerves when the beach-chair position is used. These injuries are caused by arm and leg positioning, respectively; thus, these regions must be well padded and remain free from pressure.[2] The hips are flexed 45° to 60°, with the knee flexed to 30° to relax the sciatic nerve. The nonsurgical arm is either tucked at the side or placed onto an arm holder. Patients can be seated at angles varying from 30° to 80° above the horizontal plane. For shoulder arthroplasty, the table is usually elevated to between 30° and 50° in contrast to the higher elevation used for arthroscopic cases (60° to 80°).

Precise positioning of the surgical arm can be achieved through various

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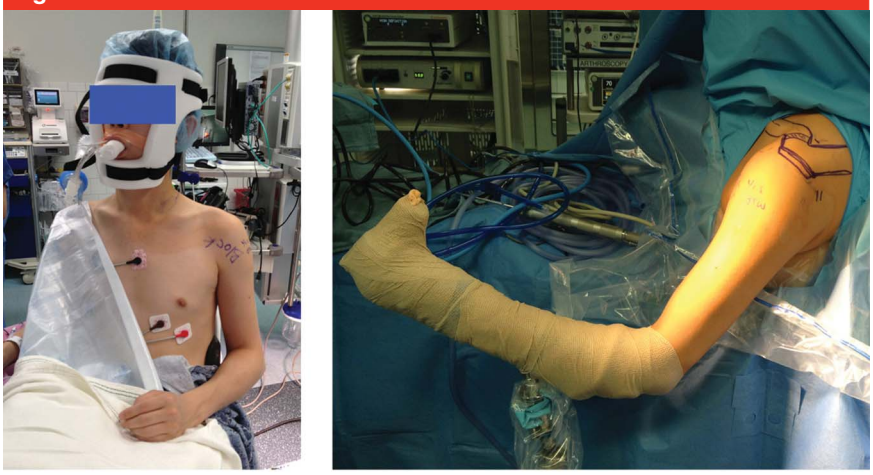
Figure 2



A B

A, Photograph demonstrating modern beach-chair positioning with the patient sitting in an upright position (between 70° to 90°) and the head secured in a headrest with well-padded straps. **B**, Photograph showing a Spider limb positioner (Smith & Nephew) attached to the side of the table to facilitate arm positioning during the operation.

methods. No upper extremity traction device is required; the arm can be left free and placed on a padded table with manual traction provided by an assistant when necessary. Two commonly used mechanical arm holders include the manually operated, locking McConnell arm holder (McConnell Orthopaedics) and the pneumatic Spider limb positioner (Smith and Nephew; Figure 2, B). Some surgeons may prefer arm holders because rotation of the arm affects visibility within the joint and tension on the tissues (labrum or capsule) being repaired.

A variety of methods can be used to secure the head within the head-holding device. A single strap placed across the forehead has been improved by the addition of a second strap around the chin, securing the head in perpendicular planes. A unique, cost-effective method of providing two-point fixation involves using the strap of the patient's postoperative sling to secure the head to the holder.[8] The head must be in a neutral position at all times because extension and rotation can reduce vertebral artery blood flow, resulting in posterior brain circulation infarcts, and flexion can impede cerebral venous drainage by causing an obstruction of the internal jugular veins.[9] General anesthesia can be administered with the patient supine or seated. Although not routine, cerebral perfusion can be monitored by different methods, including near-infrared spectroscopy or jugular venous bulb oxygen saturation.[10] Good communication with the anesthesiologist throughout the procedure is essential for blood pressure management while the arthroscopic pump pressure is adjusted to maximize visualization and minimize complications.

Lateral Decubitus Setup

Positioning and traction devices are essential for the lateral decubitus position setup. Positioning devices can be subcategorized into bed types, patient stabilization devices, and padding. Most operating room tables can be used with either a beanbag or rigid post system such as a pegboard. The beanbag requires suction for a secure fit and may lose rigidity over time if damaged (Figure 3, A). The advantages of the pegboard or rigid post system are that no suction is required, intraoperative patient position variances or changes are less likely, and patient size is less of a factor. The surgical extremity is placed in a sling and traction is applied in a longitudinal fashion with weights (Figure 3, B). The amount of traction used is important to allow adequate visualization while minimizing the risk of neurovascular damage or injury. Padding is critical to avoid pressure and neurologic injuries. An axillary roll is placed under the axilla to relieve pressure on the brachial plexus. The knee is slightly bent and the fibular head of the lower leg is padded to prevent pressure injuries to the common peroneal nerve.

Traction devices can be categorized as static pulley/traction devices or adjustable pneumatic or mechanical devices. Most of the pneumatic and mechanical traction devices commonly used with the beach-chair position can be adapted for the lateral decubitus position. The ability to achieve a large number of arm positions is a potential advantage of these devices. Disadvantages include added equipment and a requirement for compressed air. Static pulley devices rely on simple traction and are typically adjusted with the application of weight. Arm motion and positions are limited to simple abduction/adduction with these devices. Some devices have the ability to introduce rotational adjustment, but the degree to which this changes the shoulder's position and arthroscopy views is unclear. The advantages of the static pulley device are decreased cost and a relatively simple setup.

Beach-chair Versus Lateral Decubitus Position

Ease of Setup and Time

Surgeons' preferences for patient positioning are largely based their training experiences. Advocates for beach-chair and lateral decubitus positions have valid arguments for the use of both methods with respect to number of steps, amount of equipment, and number of assistants needed.[7,11] However, these arguments can be biased because of familiarity with one setup versus the other. Both positions require extra assistance and may require further adjustments during surgery. These factors can have an impact on surgical time and the ease of the overall setup. For the beach-chair position, an assistant may be required to apply traction during surgery if a mechanical arm holder is not available or if the joint requires distraction for instability procedures. In contrast, the lateral decubitus position requires assistants for turning and positioning the patient onto the beanbag after intubation, setting up the traction device, and rotating the humerus, if necessary, during surgery. Currently, no objective studies have compared the amount of time required for each setup or the number of assistants needed for patient positioning.

Conversion to an Open Approach and Anesthesia

Proponents of the beach-chair position have argued that one of its advantages is the ease of conversion from an arthroscopic to an open procedure.[11,12] However, the true benefit is difficult to assess because the need to convert to an open procedure is rare for experienced surgeons. The beach-chair position also offers the flexibility of using general or regional anesthesia for the procedure.[11] Furthermore, it allows for easy airway access if complications arise during surgery and the patient needs to be placed in the supine position.

Several authors have hypothesized that cerebral ischemia may occur with controlled hypotension during shoulder surgery when the anesthetized patient is brought up to a sitting position of 45° to 90°[13,14] (Table 1). In the anesthesia literature, the current expert recommendation is to keep the systolic blood pressure (SBP) >90 mm Hg and the maximum reduction of both the SBP and mean arterial pressure (MAP) to within <20% of baseline measurements to prevent cerebral hypoperfusion.[15] In a prospective study that evaluated the safety of controlled hypotension for shoulder arthroscopy performed using the beach-chair position, the authors reported no electroencephalographic changes with a maximal reduction of 35% and 42% of the baseline SBP and MAP, respectively.[15] These results suggest that patients may safely tolerate a SBP <90 mm Hg and a lower MAP during shoulder arthroscopy without increasing the risk of cerebral desaturation events. Soeding et al[16] found that cerebral blood flow was maintained in the beach-chair position with a MAP >70 mm Hg. In another study of arthroscopic surgery performed with this position, the use of a sequential compression device reduced the incidence of hypotension from 64% to 28% and helped to maintain the MAP.[17]

Using near-infrared spectroscopy to evaluate intraoperative cerebral oxygen desaturation events, Murphy et al[18] reported a substantially higher incidence of cerebral desaturation events (CDEs) during shoulder arthroscopy in patients positioned in the beach-chair position versus the lateral decubitus position (80.3% versus 0%). CDEs were defined as a ≥20% decrease in baseline regional cerebral oxygen saturation. A higher incidence of postoperative nausea and vomiting was observed in the patients with intraoperative CDEs. However, there was no significant difference between the two positions in terms of hemodynamic and systemic oxygenation variables (heart rate, MAP, and pulse oximetry). Furthermore, despite the increase in CDEs associated with the beach-chair position, no obvious neurologic deficits were observed. In

Figure 3

A B

A, Clinical photograph demonstrating the lateral decubitus setup with the patient positioned on a beanbag. **B,** Clinical photograph demonstrating placement of the surgical extremity. The arm is flexed to 90° and placed in a sling, with traction applied with a pulley system and weights.

Table 1

Advantages and Disadvantages of the Lateral Decubitus and Beach-chair Positions for Arthroscopic or Open Shoulder Surgery

Position	Advantages	Disadvantages
Lateral decubitus	Traction increases space in the glenohumeral joint and subacromial space	Nonanatomic orientation (ie, glenoid is parallel to the floor)
	Traction accentuates labral tears	Must reach around arm for anterior portal
	Operating room table and/or patient's head not in the way of posterior and superior shoulder	May need to reposition and redrape to convert to open procedure
	Cautery bubbles move laterally out of view	Not ideal for patients who cannot tolerate regional anesthesia
	No increased risk of hypotension/bradycardia	Traction can cause neurovascular and soft-tissue injury.
	Better cerebral perfusion	Increased risk of injury to axillary and musculocutaneous nerves when placing anteroinferior portal
Beach-chair	Upright, anatomic position	Potential mechanical blocks (eg, the head) to the use of arthroscope in posterior or superior portals
	Ease of examination under anesthesia and ability to stabilize the scapula	Increased risk of hypotension/bradycardia causing cardiovascular complications (ie, cerebral ischemia)
	Arm not in the way of anterior portal	Cautery bubbles obscure view in the subacromial space.
	No need to reposition or redrape to convert to open procedure	Fluid can fog camera if there is a leak in the attachment or in certain cameras.
	Can use regional anesthesia with sedation	Theoretically increased risk of air embolus
	Mobility of surgical arm and ability to set up arm holder to the operating room table	Expensive equipment if using beach-chair attachment with or without mechanical arm holder

a study of 20 adult patients who underwent shoulder arthroscopy in the beach-chair position, Moerman et al[19] reported that 80% of patients had intraoperative CDEs detected with near-infrared spectroscopy. Koh et al[20] observed significantly fewer CDEs in patients who received regional anesthesia and sedation compared with those who received general anesthesia during shoulder surgery performed using the beach-chair position (0% versus 56.7%). Aguirre et al[21] reported similar findings in patients undergoing shoulder surgery with regional anesthesia in the beach-chair position; patients in the regional anesthesia group had significantly decreased CDEs and better neurobehavioral tests 24 hours after surgery than did those in the general anesthesia group ($P < 0.001$). Salazar et al[22] examined patient risk factors for CDEs during shoulder arthroscopy in the beach-chair position and observed a significant association between increased body mass index and intraoperative CDEs.

Overall, there is strong evidence that patients who undergo shoulder arthroscopy in the beach-chair position have an increased risk of intraoperative CDEs; however, the duration and degree of these events required to produce a transient or permanent neurocognitive deficit is unknown. Furthermore, controlled hypotension during shoulder arthroscopy is a safe and effective method of improving visualization, and recent studies suggest that patients may be able to tolerate a lower SBP and MAP value than the current recommended minimal levels without increased risk of neurocognitive deficits.[15,16] In the anesthesia literature, the use of cerebral oximetry in higher-risk patients during shoulder arthroscopy in the beach-chair position has been recommended to aid in recognition and management of decreased cerebral perfusion during surgery.

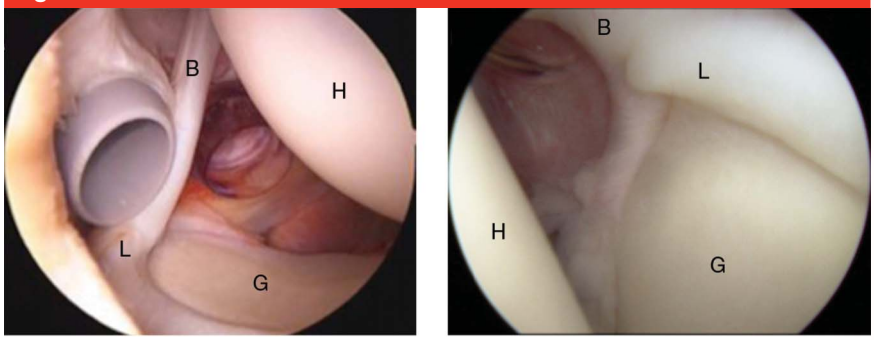
Orientation and Visualization

In terms of image orientation and visualization of anatomic structures, the advantages and disadvantages of the beach-chair and lateral decubitus positions have been contentiously debated. Proponents of the lateral

decubitus position stress the importance of orienting the glenoid parallel to the floor, which can be a useful reference point[11] (Figure 4). Furthermore, in the lateral decubitus position, the use of arm traction with weights will increase the working space for instrumentation within the glenohumeral joint. Visualization of shoulder anatomy via arthroscopic means may be affected by surgeon preference, experience, and comfort level with the set-up of a particular position rather than with the position itself.

The beach-chair position provides an upright vantage point for anatomic visualization that may aid surgeons in performing certain procedures and instructing trainees.[7,11,23] Proponents of the beach-chair position contend that the ease of external shoulder landmark palpation allows for accuracy of portal placement. Surgeons are also able to stabilize the scapula in this position to allow examination under anesthesia. It has been argued that the beach-chair position provides better visualization and access to the anterior shoulder structures compared with the lateral decubitus position.[2] Procedures such as anterior stabilization, releases, and rotator cuff repairs, as well as insertion of anchors into the glenoid neck below the 4-o'clock position, are easier when performed in the beach-chair position.[7,23] Furthermore, the anteroinferior capsule and axillary region can be accessed by lateral translation of the humerus with the patient in the beach-chair position.[4] This lateral translation and joint distraction can be further improved by placing a bump underneath the axilla (Figure 5). However, Pearsall et al[24] found that the risk of injury to the cephalic vein and cartilage increased when a five-o'clock portal was used for instability procedures performed using the beach-chair position. In contrast, Gelber et al[12] showed a decreased risk of injury to the musculocutaneous and axillary nerves when a 5-o'clock anteroinferior portal was established for labral repair with patients in the beach-chair position compared with those in the lateral decubitus position. Furthermore, the beach-chair position allows for tension-free repair of capsular anatomy.[7,12]

Figure 4



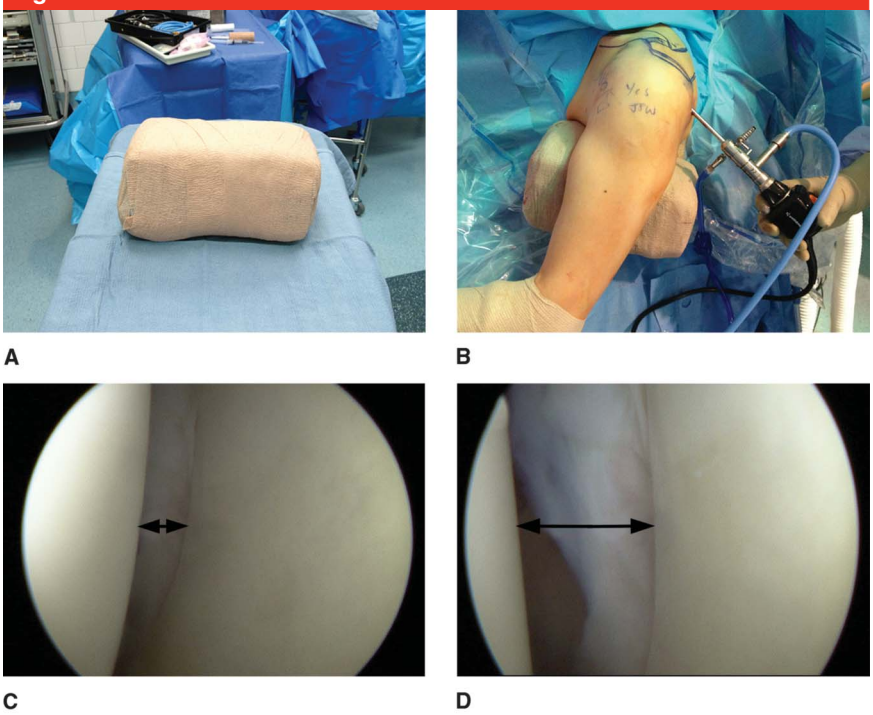
A B

Arthroscopic visualization of the glenohumeral joint with the patient in the lateral decubitus position (**A**) and beach-chair position (**B**). In the lateral decubitus position, the glenoid is visualized in the horizontal plane and, in the beach-chair position, it is visualized in the vertical or anatomic plane. G = glenoid, H = humeral head, B = biceps tendon, L = superior labrum

Drawbacks of the beach-chair position include the head acting as a mechanical block for the posterior and superior portals, fogging of the camera lens, and collection of bubbles in the subacromial space.[7,25] However, with the modern beach-chair setup and the ability to adjust the head position, there is less concern with the position of the head compromising portal placement. Furthermore, a transrotator cuff portal can be used for better arthroscopic visualization during posterior Bankart repair if difficulties are encountered with portal positions.[26]

Proponents of the lateral decubitus position argue that the traction on the arm allows increased intra-articular space, thus providing better access to the anterior and posterior labrum, subacromial space, inferior capsule, and underside of the rotator cuff.[11,25] Furthermore, the patient's head is not in the way of instrumentation when working at the posterior and superior aspects of the shoulder. Gross and Fitzgibbons[27] described a modified approach for the standard lateral decubitus position in which the patient is rotated 30° to 40° posteriorly to put the shoulder joint and glenoid on a horizontal plane. Additionally, the authors advocated traction in a plane perpendicular to the long axis of the humeral shaft to elevate the humeral head out of the glenoid rather than subluxating it inferiorly. Baechler and Kim[28] recommended patient positioning based on the morphology of the lateral acromion. If there is an increase in the lateral coverage of the humeral head by the acromion and if inferior displacement of the humeral head of ≥25% of the humeral head diameter is needed to allow adequate arthroscopic access to the superior glenoid or labrum through a lateral portal, then the authors recommend the use of the lateral decubitus position with continuous arm traction to improve arthroscopic accessibility.

Figure 5



A, Clinical photograph demonstrating a bump made with towels and a self-adherent wrap. **B,** The bump is placed under the axilla of the surgical extremity. **C** and **D**, Arthroscopic images demonstrating the distraction of the glenohumeral joint (double arrows), which improves visualization and provides increased room in the joint for the instrumentation used for instability procedures. The orientation of the glenoid is upright (ie, anatomic) when the patient is in the beach-chair position.

Complications

Neurapraxia

Complications in shoulder arthroscopy associated with the lateral decubitus or beach-chair position can be categorized as related to position or anesthesia (Tables 2 and 3). Nerve injuries associated with shoulder arthroscopy have been well documented in the literature and are caused by traction or portal placement. The reported incidence of transient nerve paresthesia/palsy associated with the lateral decubitus position ranges from 10% to 30% and is attributed to excessive strain on the brachial plexus as a result of intraoperative traction.[7,11] In a cadaver study, Klein et al[49] evaluated brachial plexus strain in shoulders in different positions and concluded that 45° of forward flexion with 0° or 90° of abduction allows for maximal visualization with minimal strain on the brachial plexus. Although the reported incidence of traction-related nerve injuries is high, persistent clinical neurapraxia is relatively rare. In a study of 120 patients who underwent shoulder arthroscopy in the lateral decubitus position, Andrews et al[29] reported neurapraxia of the musculocutaneous (one patient) and ulnar nerves (two patients). Ogilvie-Harris and Wiley[31] reported one case of musculocutaneous nerve palsy in 439 patients who underwent shoulder arthroscopy in the lateral decubitus position. Ellman[6] reported on three cases of neurapraxia of the dorsal digital nerve of the thumb caused by poor padding in patients placed in lateral decubitus position.

In contrast to these findings, Rodeo et al[50] reported no cases of nerve palsy in patients placed in the beach-chair position during shoulder arthroscopy. However, Park and Kim[39] reported that inadequate padding around the head resulted in cutaneous facial neurapraxia in patients placed in this position. Furthermore, hypoglossal nerve palsy has been reported after open and arthroscopic shoulder surgery performed with the patient in the beach-chair position.[40] This may be related to external nerve compression caused by changes in neck position during the procedure. Spinal cord infarction and mid-cervical quadriplegia caused by excessive neck flexion have been reported in neurosurgical procedures performed with the patient in an upright position. However, this complication has not been reported in open shoulder surgery or arthroscopy.[51]

Anesthesia

Deliberate hypotensive anesthesia is an effective technique for reducing blood loss and helping to maintain a clear surgical field; however, anesthesia-related complications have been associated with this technique.[51] In arthroscopic surgery, a safe and clear surgical field can be achieved by maintaining a difference of ≤49 mm Hg between the SBP and the pressure measured within the subacromial space.[52] This can be achieved via a combination of modest elevation in pump pressure and deliberate systemic hypotension.

Hypotensive anesthesia carries the risk of ischemic brain and spinal cord injuries; however, these complications are rare. Pohl and Cullen[13] reported on four cases of ischemic brain and spinal cord injury after open and arthroscopic procedures performed with the patients in a semi-upright position. Hypotensive bradycardic

Table 2

Complications Associated with the Lateral Decubitus Position for Arthroscopic Shoulder Surgery

Study (Type)	No. of Patients	Complications	Other Factors
Ellman[6] (retrospective review)	40	3 neurapraxias of dorsal digital nerve of the thumb	Poor padding
Andrews et al[29] (retrospective review)	120	1 musculocutaneous and 2 ulnar nerve neurapraxias	NR
Paulos and Franklin[30] (retrospective review)	76	1 axillary nerve neurapraxia with deltoid dysfunction	NR
Ogilvie-Harris and Wiley[31] (retrospective review)	439	1 musculocutaneous nerve palsy	NR
Zeidan et al[32] (case report)	1	1 postoperative brain stroke	NR
Burkhart et al[33] (case report)	1	1 DVT	Patient had a history of Hogkins Lymphoma
Edgar et al[34] (Case series)	3	Nonfatal PE	2 patients had risk factor for DVT or PE
Kuremsky et al[35] (retrospective review)	1,908	6 patients with a total of 5 DVTs and 4 PEs	3 of 6 patients had risk factors. All 6 patients required hospitalization and treatment.
Garofalo et al[36] (case report)	2	2 patients with DVTs	NR
Hynson et al[37] (case report)	1	Airway obstruction	Extra-articular spread of arthroscopic irrigant fluid
Pavlik et al[38] (case report)	1	Contralateral C7-T1 brachial plexus neurapraxia	Lateral positioning and unknown cervical ribs

DVT = deep vein thrombosis, NR = not reported, PE = pulmonary embolism

episodes are defined as a decrease in heart rate of at least 30 beats/min within a 5-minute interval, any heart rate <50 beats/min, and/or a decrease in SBP of >30 mm Hg within a 5-minute interval or any systolic pressure <90 mm Hg. Although these hypotensive bradycardic episodes are relatively common occurrences in shoulder arthroscopy (reported incidence of approximately 30%), only one case of an asystolic cardiac arrest has been reported.[41] Metoprolol has been used as a chemical prophylaxis to prevent hypotensive bradycardic episodes, but its effectiveness has not been well established.[53] Friedman et al[54] surveyed members of the American Shoulder and Elbow Surgeons to examine the prevalence of cerebrovascular (CV) events during shoulder surgery and found that the overall rate of intraoperative CV events was 0.00291% (8 of 274,225 procedures), with all events occurring in surgeries in which the beach-chair position was used. However, when the data were adjusted for confounding variables, the authors found no significant difference in the rate of CV events associated with the beach-chair and lateral decubitus positions. Postoperative brain stroke after shoulder arthroscopy performed with the patient in the lateral decubitus position has also been reported.[32]

Deep Vein Thrombosis and Pulmonary Embolism

Deep vein thrombosis (DVT) and pulmonary embolism (PE) events are common complications associated with lower extremity surgery and are rarely reported after upper extremity surgery, especially shoulder arthroscopy. Burkhart[33] was the first person to report on a case of DVT after shoulder arthroscopy (lateral decubitus position) in a patient with Hogkins lymphoma. Edgar et al[34] reported on three patients who developed nonfatal PE following elective shoulder arthroscopy using the lateral decubitus position. All symptoms (chest pain, shortness of breath, scapular pain) appeared within 30 days after surgery. Two of three patients had risk factors for DVT or PE. In a study of thromboembolic events after shoulder arthroscopy in 1,908 patients, Kuremsky et al[35] identified 6 patients with thromboembolic events (five DVTs and four PEs; 0.31% prevalence) over a 5-year period. All six patients had arthroscopic shoulder surgery in the lateral decubitus position with arm traction. Only three patients in this series had identifiable risk factors, but all six required

Table 3

Complications Associated With the Beach-chair Position for Arthroscopic Shoulder Surgery

Study (Type)	No. of Patients	Complications	Other Factors
Pohl and Cullen[13] (case series)	4	Ischemic brain and spinal cord injury	NR
Park and Kim[39] (case series)	3	Neurapraxia of the lesser occipital nerve and great auricular nerve (branches of superficial ascending branches of the cervical plexus)	Degree of rotation and deviation of head and neck, compression by the head strap and elastic bandage
Mullins et al[40] (case report)	1	Hypoglossal nerve palsy	Nerve compression caused by position change in procedure
D'Alessio et al[41] (retrospective review)	116	1 asystolic cardiac arrest	NR
Bongiovanni et al[42] (case series)	3	3 patients with DVT	All patients with heritable thrombophilia discovered after the DVT complication
Creighton and Cole[43] (case report)	1	1 patient with upper extremity DVT	NR
Cortés et al[44] (case report)	1	1 patient with DVT and subsequent PE	NR
Cho et al[45] (case series)	2	Ventricular tachycardia resulting in cardiogenic shock	Infusion of irrigation solution containing epinephrine
Lee et al[46] (case series)	3	Subcutaneous emphysema, pneumomediastinum, and tension pneumothorax	Shoulder arthroscopy with subacromial decompression
Bhatti and Enneking[47] (case report)	1	Unilateral vision loss and ophthalmoplegia	NR
Ng and Page[48] (case series)	3	3 patients with neurapraxia of the great auricular nerve	Use of horseshoe headrest

DVT = deep vein thrombosis, NR = not reported, PE = pulmonary embolism

hospitalization and subsequent anticoagulation. Garofalo et al[36] reported on two cases of upper extremity DVT after shoulder arthroscopy using the lateral decubitus position with arm traction. Analysis of the literature revealed five case reports of thromboembolic events after shoulder arthroscopy using the beach-chair position.[42-44] However, three of these involved patients with heritable thrombophilia that was undetected until after the complications of DVT.[42] Overall, the incidence of thromboembolic events associated with shoulder arthroscopy is extremely low, and more events are related to surgery performed using the lateral decubitus position than the beach-chair position. Most patients who develop DVT or PE after shoulder arthroscopy have risk factors or heritable coagulation abnormalities. Despite the low risk of a thromboembolic event with shoulder surgery, the surgeon must be cognizant of the clinical symptoms associated with these events to ensure accurate diagnosis and appropriate management.

Other Complications

Irrigation-related complications associated with patient positioning for arthroscopic shoulder surgery have been reported in the literature. Cho et al[45] reported on two cases of sudden ventricular tachycardia that resulted in cardiogenic shock after infusion of an irrigation solution that contained epinephrine was administered to patients in the beach-chair position. Hynson et al[37] reported one case of airway obstruction caused by extra-articular spread of arthroscopic irrigant fluid in a patient placed in the lateral decubitus position.

Lee et al[46] reported on three cases of subcutaneous emphysema, pneumomediastinum, and tension pneumothorax after shoulder arthroscopy with SAD performed using the beach-chair position. Air embolism and PE are more commonly associated with lower extremity arthroplasty procedures, but they have been reported in the shoulder arthroscopy literature. Surgeons should be aware of these potential complications and consider

the use of prophylactic measures for patients with identified coagulopathy disorders.

Unilateral vision loss and ophthalmoplegia after shoulder arthroscopy have also been reported in the literature, but these complications are rare.[47] Unilateral hearing loss after nonotologic surgery is also rare; most of the previously documented cases occurred in patients undergoing cardiopulmonary bypass. However, Ng and Page[48] reported on three cases of neurapraxia of the great auricular nerve caused by compression with the headrest device in patients in the beach-chair position. Park and Kim[39] reported one case of neurapraxia of the great auricular and lesser occipital nerves secondary to the design of the headrest for the beach-chair setup. Contralateral brachial plexus palsy has also been reported after shoulder arthroscopy.[38]

Summary

Advantages of the lateral decubitus position for shoulder surgery include better visualization and instrument access for certain procedures; however, the beach-chair setup may be easier or quicker to set up and gives the surgeon the option to convert to an open procedure without changing the setup. Complications associated with the lateral decubitus position for shoulder surgery include traction injuries that can result in neurapraxia, injury to the brachial plexus, and thromboembolic events as well as difficulty with anesthesia with regard to airway management. Patients in the beach-chair position may experience cerebral hypoperfusion and complications ranging from cranial nerve injuries to infarction. Recent evidence suggests that patients undergoing hypotensive anesthesia in the beach-chair position may safely tolerate a greater reduction in blood pressure than the current recommended guidelines based on expert opinion (SBP >90 mm Hg and maximum reduction in SBP and MAP <20% of baseline values). However, cerebral oxygenation monitoring is recommended for high-risk patients. Other complications have also been described, including cervical nerve traction neurapraxias, blindness, deafness, and cardiac or embolic events associated with the upright position, but these complications are rare. The surgeon must be cognizant of the complications associated with both patient positions and should take extra care in the setup, coordinating with the anesthesiologist during initial patient positioning to minimize the risks of complication and patient morbidity.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 15-17, 20, and 21 are level I studies. References 10, 18, 19, and 22 are level II studies. References 35 and 41 are level III studies. References 6, 7, 13, 26, 28, 36, 42, 45, 46, 50, and 52 are level IV studies. References 3, 8, 9, 11, 12, 14, 24, 25, 27, 29, 31, 49, 51, and 54 are level V expert opinion.

References printed in **bold type** are those published within the past 5 years.

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