CURRENT THERAPEUTIC RESEARCH

VOLUME 71, NUMBER 6, DECEMBER 2010

Case Report

Tracheal Compression During Shoulder Arthroscopy in the Beach-Chair Position

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ABSTRACT

BACKGROUND: Respiratory distress is a rare complication of outpatient shoulder arthroscopy and mostly associated with general anesthesia, pneumothorax, anaphylaxis, or phrenic nerve paralysis.

OBJECTIVE: We report on a shoulder arthroscopy complicated by tracheal compression caused by extravasation of irrigation fluid into soft tissues of the upper airway while the patient was in the beach-chair position under general anesthesia.

CASE SUMMARY: A 33-year-old male was scheduled for shoulder arthroscopy for impingement syndrome of the right shoulder under general anesthesia combined with interscalene brachial plexus block. During the operation, the patient's neck, right chest, and shoulder were observed to be swollen and tense on palpation. A fiberoptic bronchoscopic evaluation through the endotracheal tube revealed that the trachea was compressed to the left, but not completely obstructed. It was determined that the irrigation fluid had leaked subcutaneously from the shoulder joint to the neck. Vital signs were stable and the patient could be adequately ventilated despite the airway obstruction. The patient was transferred to the ward 16 hours after the operation with stable vital signs and discharged from the hospital on the second day.

CONCLUSIONS: We report a case of airway obstruction due to tracheal compression from extravasation of irrigation fluid during shoulder arthroscopy under general anesthesia combined with peripheral nerve block in the beach-chair position. General anesthesia with endotracheal intubation protected the patient from a possibly fatal complication. (*Curr Ther Res Clin Exp.* 2010;71:408–415) © 2010 Elsevier HS Journals, Inc.

KEY WORDS: shoulder arthroscopy, general anesthesia, tracheal compression, beach-chair position.

Accepted for publication October 19, 2010.

doi:10.1016/j.curtheres.2010.12.003
0011-393X/$ - see front matter

INTRODUCTION

Shoulder arthroscopy has become a routine procedure during the past 2 decades. It has advantages over "open" surgery including reduced blood loss and postoperative pain, lower infection rate, and shorter hospital stay, especially in an outpatient setting.[1,2] Shoulder arthroscopy can be performed under general or regional anesthesia in respect to the patient's choice and availability of the technique.[1,3] Orthopedic surgeons prefer either the lateral decubitus position (LDP) or the beach-chair position (BCP) to perform arthroscopic shoulder procedures with the aim to provide better visualization of, and easier access to, the surgical site.[4] There is no objective evidence to support that either position is superior for the procedure. The supporters of BCP report that the upright, anatomic position makes orientation and teaching easier. However, the proponents of LDP report that the traction in the LDP increases space in the joint and subacromial space. The BCP has been criticized for causing decreased visibility due to fogging of the camera and the collection of bubbles in the subacromial place. On the other hand, the LDP requires repositioning and redraping to convert to an open procedure. Both positions require assistance for positioning the patient and also for the traction of the arm.

Shoulder arthroscopy is a relatively safe technique, but it is not free of complications (**Table**). Complications reported in the literature range from infection to cerebral ischemia depending on the anesthesia, surgical procedure, and the patient's position (LDP or BCP).[2,4] Respiratory distress is a rare but life-threatening complication of shoulder arthroscopy and mostly caused by pneumothorax, phrenic nerve paralysis, and anaphylaxis.[1,3] There are few case reports in the literature that note respiratory distress during shoulder arthroscopy due to extra-articular spread of irrigation fluid into the soft tissues of the upper airway.[5] Extravasation of the irrigation fluid can be diagnosed with physical examination and imaging techniques. The swelling of the soft tissues is markedly visible and tense and cold on palpation. A chest radiograph examination is useful to show tissue enlargement on the ipsilateral side.[6,7] Additionally, ultrasound demonstration of tissue fluid infiltration has been reported.[8] Most of these procedures were performed under regional anesthesia in LDP.[2,3] We report a case of serious airway obstruction in a patient whose shoulder arthroscopy was complicated by tracheal compression while the patient was in the BCP under general anesthesia.

CASE SUMMARY

A 33-year-old (weight, 80 kg; height, 183 cm) male was scheduled for shoulder arthroscopy (acromioplasty and repair of the rotator cuff) for impingement syndrome of the right shoulder. His medical history revealed pain with arm movement during the past 3 months. He had no other medical conditions or allergies and airway examination showed a Mallampati class I airway.[9] The patient was informed that the surgery could be performed under general or regional anesthesia and it was decided to combine general anesthesia with interscalene brachial plexus block (IBPB) for postoperative pain treatment according to the patient's preference. Written informed consent was obtained from the patient for the surgery and anesthesia. The patient also provided written consent for the publication of the case including the use of photographs.

Table. Potential complications of arthroscopic shoulder surgery.

Complications Related to the Surgery	Complications Related to the Anesthesia	Complications Related to the Positioning of the Patient
a. Infection	a. General anesthesia	a. Beach-chair position
b. Vascular injury	b. Regional anesthesia	i. Reduced cerebral perfusion
c. Neurologic injury	i. Nerve injury	ii. Loss of vision
d. Tendon injury	ii. Local anesthetic toxicity	iii. Stroke
e. Heterotopic ossification	iii. Pneumothorax	iv. Ophthalmoplegia
f. Fluid extravasation	iv. Hemothorax	v. Stretching of the brachial plexus
g. Pneumothorax	v. Paresis of ipsilateral hemidiaphragm	vi. Abnormal pressure to heels and knees
h. Hemothorax	vi. Vascular injury	b. Lateral decubitus position
i. Thromboembolism	vii. Air embolism	i. Subclavian vein occlusion
j. Fracture		ii. Atelectasis of the dependent lung
		iii. Abnormal pressure to muscles, eyes, and ears
		iv. Compression injury to the brachial plexus

On the day of the operation, an intravenous line was inserted on the patient's left arm and 2 mg midazolam, 10 mg metoclopramide, and 50 mg ranitidine were administered intravenously for premedication. After arriving in the operating room, the patient was monitored via ECG, peripheral oxygen saturation (SpO_2), and noninvasive blood pressure (NIBP). A single-shot IBPB was performed according to Winnie's approach with a 35-mm insulated stimulating needle under the guidance of a nerve stimulator (Stimuplex HNS 12 Nerve Stimulator, Braun Melsungen AG, Germany).[10] A total of 40 mL of a regional anesthetic mixture containing 10 mL 0.5% bupivacaine and 10 mL 2% lidocaine diluted with 20 mL normal saline was administered through the needle after appropriate twitches of the brachial plexus were elicited at 0.5 mA. After determining the motor and sensorial block in the right arm with pinprick and cold-sensation tests, general anesthesia was initiated with IV propofol 200 mg, fentanyl 100 µg, and vecuronium 8 mg. Three minutes later, the trachea was intubated with an 8.0-mm internal diameter endotracheal tube (ETT). The position of the ETT was confirmed with auscultation of the lungs and capnography and it was fixed at a depth of 21 cm with adhesive tape. Anesthesia was maintained with sevoflurane in a mixture of oxygen/nitrous oxide. The ventilatory settings were adjusted for a tidal

volume of 600 mL (ventilatory frequency, 12 breaths/min) to maintain the end-tidal carbon dioxide ($EtCO_2$) level between 30 and 35 mm Hg. The patient was in the BCP with the left arm tied to the armrest and a belt placed over the knees. Silicone pads were used to support the head, knees, and heels. The head was fixed with an adhesive band to prevent uncontrolled lateral flexion. Surgery was then allowed to begin.

Arthroscopic instruments were inserted into the shoulder joint through a skin incision. Ringer's lactate solution was infused using an automatic arthroscopic pump with pressures varying between 50 and 80 cm of water (H_2O) to irrigate and extend the shoulder joint.

The operation was uneventful during the first 140 minutes. After this time, the peak inspiratory pressure started to rise gradually from 18 to 35 cm H_2O in ~4 minutes. The $EtCO_2$ level increased to 52 mm H_2O and the capnographic curve showed a sloped shape indicating an obstructive pattern. SpO_2 decreased from 98% to 93%, but no further decrements were observed. NIBP and heart rate did not change. It was thought that the ETT might have advanced into the right main bronchus or an obstruction had developed. Breath sounds were auscultated bilaterally equal and there was no wheezing. Nothing was aspirated through the ETT via the suction catheter. The part of the ETT in the mouth was checked manually, but there was no kinking or biting of the tube. Surgery was discontinued and the drapes were removed. The patient's neck, right chest, and shoulder were observed to be swollen and tense on palpation. The subcutaneous swelling extended from the shoulder to the mandible and the clavicle could not be palpated. A portable chest radiograph examination showed soft tissue swelling in the right shoulder and neck and pneumothorax and hemothorax were excluded. A fiberoptic bronchoscopic (FOB) evaluation through the ETT revealed that the trachea was compressed to the left, but not completely obstructed. After having checked and eliminated these possible reasons, it was assumed that the irrigation fluid had leaked subcutaneously from the shoulder joint to the neck. The operation was continued because vital signs were stable and the patient could be adequately ventilated despite the airway obstruction. A urinary bladder catheter was inserted and 20 mg furosemide and 8 mg dexamethasone were administered intravenously for diuresis and antiedema treatment. The surgery was completed 35 minutes later. The use of the irrigation fluid with arthroscopic pump was discontinued 6 minutes after the discovery of the leaking irrigation fluid. During this time, the pressure of the pump was reduced and settled between 40 and 60 cm H_2O. Although shoulder arthroscopy is normally performed on an outpatient basis, the patient was transferred to the intensive care unit, intubated, and sedated as a result of this unanticipated complication. He was seated upright in the bed. After 10 hours, the swelling of the neck resolved and it was observed at FOB evaluation that the compression of the trachea had resolved as well. Sedation was discontinued and the patient woke up and breathed spontaneously after 10 minutes. The mouth was carefully aspirated and the cuff of the ETT was deflated. The patient could inspirate around the ETT when it was occluded. The ETT was removed and oxygen was given via nasal cannula. The patient was transferred at the postoperative 16th hour with stable vital signs to the ward and discharged from the hospital on the second day.

DISCUSSION

The complications of shoulder arthroscopy increase in parallel with the arthroscopic technique used and are reported to occur in 5.8% to 9.5% of patients.[1] Complications related to shoulder arthroscopy are not uncommon. The rate of possible complications ranges from 2% to 5% depending on factors such as the nature of the procedure and experience of the surgeon. Among them, neurapraxia, intraoperative bleeding, fluid extravasation, and infection are most commonly reported.[2–5] Respiratory distress during shoulder arthroscopy is a rare complication (2.8%) and mostly associated with pneumothorax or paresis of ipsilateral hemidiaphragm due to IBPB. The phrenic nerve is paralyzed in ~100% of all IBPBs and can result in a reduction of pulmonary reserve of up to 25%.[11] Therefore, IBPB is not recommended in patients with limited pulmonary functions.

During arthroscopic procedures, leakage of irrigation fluid into surrounding tissue planes is a frequently noticed phenomenon usually clinically asymptomatic and resolving within 12 hours postoperatively. Although rare, this fluid may produce life-threatening complications such as airway compromise. Fluid leakage is frequent during shoulder arthroscopy and generally results in minor issues including weight gain and soft tissue edema.[12] Two different studies investigating fluid gain during shoulder arthroscopy noted that fluid weight gain was 1.3 to 2.0 kg/h of arthroscopic surgery time.[12,13] De Wachter et al[14] conducted a prospective study (40 patients; 20 male/20 female; mean age, 51 years) that investigated the pressures in the deltoid and supraspinatus muscles and in the paratracheal region during arthroscopic subacromial decompression under general anesthesia and found that muscle pressures in almost half of their patients rose above levels that are thought to give rise to compartment syndrome; however, none of the patients developed a clinical compartment syndrome or respiratory depression. On the other hand, airway compromise differentiates this complication from the others by causing a life-threatening respiratory problem.[6] Berjano et al[2] retrospectively evaluated a series of 179 consecutive arthroscopic (n = 141) and combined (arthroscopic plus open; n = 38) procedures performed by the same surgeon. The overall complication rate was 10.06% (18/179). There was only one case of respiratory distress (0.56%, 1/179) that required reintubation and intensive care for 24 hours. The patient improved satisfactorily with no further complications after extubation. Berjano et al reported that fluid retention into deltoid muscle and chest frequently occurred and usually resolved within 12 hours.[2] The underlying mechanism of this complication is the leakage of excessive amounts of irrigation fluid into extracapsular tissues and then accumulation in the soft tissues near the neck and in the mucous membranes of the upper airway.[6] The predisposing factors established in the literature are prolonged surgery, subacromial procedures, using a high-pressure irrigation pump, and surgeon proficiency.[15,16] Other than these predisposing factors, earlier case reports revealed several findings. Most of the procedures were performed in the LDP which is believed to be more prone to developing fluid accumulation by gravitational effect.[14] The BCP, however, is a special concern for the anesthesiologists because it has unique risks for air embolism, hypotensive and bradycardic events, and brain and spinal cord ischemia.[17,18] To our knowledge, this is the first case report of a tracheal compression during arthroscopic shoulder surgery under general anesthesia in the BCP.

Therefore, in the present case, the more probable causes of respiratory problems, like obstruction or kinking of the ETT, pneumothorax, or endobronchial intubation, were considered to be the cause rather than tracheal compression due to fluid leakage. Chest radiograph showed some soft-tissue swelling in the right neck and shoulder, but there was not a remarkable tracheal deviation. A fiberoptic bronchoscopic evaluation was then performed to determine the cause of the possible obstruction. This led to a delay in diagnosis of ~15 minutes.

In a case report by Borgeat et al,[19] a 69-year-old female patient underwent shoulder arthroscopy under regional anesthesia (interscalene peripheral nerve block) and complained of neck discomfort on the ipsilateral side of the arthroscopy. The patient experienced difficulty breathing with inspiratory and expiratory wheezing during the procedure. The procedure was immediately terminated and all instruments were removed. After a large amount of subcutaneous fluid was noted extending from the chest and face, the patient was transferred to the recovery room without cardiovascular instability or decrease in blood oxygen saturation. Borgeat et al have advocated that regional anesthesia has a major advantage over general anesthesia by the fact that the patient is awake and able to report complaints during surgery. This may be a logical idea, but we do not share this opinion completely. The case reports about the airway obstruction caused by the extravasation of the irrigation fluid during the shoulder arthroscopy under regional anesthesia revealed some comparable findings. All patients who had shoulder arthroscopy under regional anesthesia were able to report their discomfort or respiratory complaints during the procedure. However, vital signs rapidly deteriorated (desaturation and bradycardia developed) in all patients except that of Borgeat et al as obstruction had progressed by the time the patient's complaints were evaluated.[7,14,19–21] Face-mask ventilations were unsuccessful and emergence endotracheal intubations were attempted, but only 2 of them were successful on the first attempt.[7,20] One patient could be intubated at the second attempt after a skin incision for tracheotomy.[21] In another case report,[7] a 77-year-old female patient underwent shoulder arthroscopy under general anesthesia with a laryngeal mask airway (LMA) placed at the beginning of the procedure; however, this patient could not be ventilated through the LMA after the extravasation of irrigation fluid and the trachea was intubated with an ETT. These findings suggest that the duration between the patients' complaints and deterioration of vital signs is too short and may result in life-threatening risks despite prompt diagnosis and management. According to these data, it may be considered that general anesthesia is the preferred anesthetic management compared with regional anesthesia in terms of airway obstruction due to tracheal compression by the extravasation of irrigation fluid. The airway of the patient in this report was secured with an ETT at the beginning of the procedure and the vital signs remained stable after development of the complication.

However, the authors of the present study support regional anesthesia for shoulder arthroscopy because it has indispensable and well-known advantages over general anesthesia, especially in the outpatient settings. Regional anesthesia is widely accepted as a tolerable and effective technique for shoulder arthroscopy with a high degree of patient acceptance.[22–25] It provides excellent intraoperative analgesia and

muscle relaxation. Postoperatively, regional anesthesia results in fewer adverse effects, fewer hospital admissions, and shorter hospital stays than general anesthesia. Also, respiratory distress is not a frequently reported complication of shoulder arthroscopy. There are few case reports[6,7,19–21] and one retrospective study about complications of shoulder arthroscopy that have reported the incidence of respiratory distress.[2]

A randomized, prospective study by Syed et al[16] (28 patients; 7 female/21 male; mean [SD] age, 52 [17] years) found that using a newly designed fenestrated outflow cannula with negative pressure reduced interstitial swelling and fluid gain compared with conventional cannula in shoulder arthroscopy.

Presently, shoulder arthroscopies are increasingly performed under regional anesthesia, especially in an outpatient setting. Therefore, some preventive measures including close monitoring, light sedation to provide continuous communication with the patient, periodic evaluation of the tissue edema, and readiness for emergency intubation should be arranged to protect the patients. Communication with the surgical team is extremely important to prevent this complication associated with long procedures and large amounts of infused irrigation fluids.[6,7,15–21]

CONCLUSIONS

We report a case of an airway obstruction due to tracheal compression from extravasation of irrigation fluid during shoulder arthroscopy under general anesthesia combined with peripheral nerve block in BCP. General anesthesia with endotracheal intubation protected this patient from a fatal complication.

ACKNOWLEDGMENTS

The authors have indicated that they have no conflicts of interest regarding the content of this article.

Drs. Ozhan and Suzer wrote the manuscript and managed the care of the patient. Dr. Cekmen prepared the manuscript for publication and managed the care of the patient. Drs. Caparlar and Eskin performed data collection.

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