

A STUDY OF PERIOPERATIVE COMPLICATIONS AND ITS CORRELATION WITH AMOUNT OF IRRIGATION FLUID USED IN PATIENTS UNDERGOING SHOULDER ARTHROSCOPY

Dr. Kaushal Kumar Sahu¹, Dr. Sanjeev Kumar Agrawal², Dr. Shakuntala Basantwani³

¹Assistant Professor Dept. of Anesthesiology Shankaracharya Institute of Medical Sciences, Junwani, Bhilai, (CG)

²Assistant Professor Dept. of Anesthesiology Shankaracharya Institute of Medical Sciences, Junwani, Bhilai, (CG)

³Professor Dept. of Anesthesiology LTMMC Sion Mumbai

Article Info: Received 20 September 2019; Accepted 23 October 2019

DOI: <https://doi.org/10.32553/ijmbs.v3i10.651>

Corresponding author: Dr. Sanjeev Kumar Agrawal

Conflict of interest: No conflict of interest.

Abstract

Introduction: Arthroscopic shoulder surgery is a minimally invasive technique performed for diagnostic and therapeutic purposes. Advances in arthroscopy permit many procedures to be performed primarily or adjunctively through the arthroscope. Commonest indications of shoulder arthroscopy is usually performed for Shoulder instability, Bankart's lesion, Supraspinatus tear, Meniscus tear, Impingement syndrome, Rotator cuff tears, Calcific tendonitis tendinitis and Frozen shoulder. Recent evidences, however, have increasingly focused on complications related to use of irrigation fluid, patient positioning and anaesthesia during shoulder arthroscopy. The risk of complications can be reduced with an experienced surgeon, lesser surgical duration, use of controlled pump pressures and controlled flow rate of irrigation fluids.

Material and Methods: The present prospective study involves an analysis of perioperative monitoring of effects of amount of irrigation fluid in patient undergoing shoulder arthroscopy. With objective to see the Effect of irrigation fluid absorption on measurable parameters and to identify whether these parameters help in predicting airway/ respiratory compromise or cardiac complications. All the patients of any ASA Grade, sex and above 18 years who were posted for shoulder arthroscopy were included in the study. 72 patients who were undergoing shoulder arthroscopy were invited to participate in this observational study. Complete histories were obtained and thorough clinical examination was carried out. Brachial plexus block with general anaesthesia were given to all the patients.

Results: Out of 72 patients 54(75%) were males and 18(25%) were females. 30 litres or less irrigation fluid is used in 47(65.3%) patients, between 30-40 litres is used in 24(33%) patients and 40 litres or more irrigation fluid is used in 1(1.4%) patient. Baseline pulse rate was 79.85 ± 8.11 per minutes, which started decreasing from T4 (1.4%) to throughout the procedure and this fall was found to be statistically significant. The maximum fall in pulse rate at 160 minutes (19.8%). Pulse rate increases from 200 minutes till the end of the surgery. Baseline mean BP was 101.63 ± 7.90 mm Hg, which started decreasing from T1 (16.1%) to throughout the procedure and this fall was found to be statistically significant. The leak test and delayed extubation in patients undergoing shoulder arthroscopy. Towards the end of procedure and prior to extubation 4(5.6%) patients showed negative leak test and hence, had delayed extubation, and 68(94.4%) patients showed positive leak test and normal extubation and statistically significant. Mid arm circumference was increased by 14.2%, neck circumference was increased by 10.4%, haemoglobin (Hb) was decreased by 6.6%, serum sodium (Na) was decreased by 4.6% and serum potassium (K) was decreased by 16.2%. Post-operative changes in all these parameters was found to be statistically significant.

Conclusion: Extravasation of irrigation fluid used during shoulder arthroscopy can be disastrous leading to various complications like airway oedema, tracheal compression extensive subcutaneous emphysema, pneumomediastinum, tension pneumothorax and air embolism. The risk of regional and systemic absorption of irrigation fluid is directly proportional to amount of irrigation fluid used and duration of surgery. The measurement of neck circumference can be a clinical predictor for airway oedema following shoulder arthroscopy. We recommend to withhold extubation when the neck circumference increases by more than 6 cm

Introduction:

Arthroscopic shoulder surgery is a minimally invasive technique performed for diagnostic and therapeutic purposes. Advances in arthroscopy permit many

procedures to be performed primarily or adjunctively through the arthroscope. It has replaced some procedures that previously were performed through open techniques. Most of these procedures are usually done in young, healthy patients, however

elderly rheumatoid patient requiring joint decompression or arthroplasty is not uncommon. The advantages include small incisions, decreased postoperative morbidity, and potentially faster rehabilitation. So, benefits of shoulder surgery can be extended to ever more frail patients with greater comorbidity who would normally be regarded as very high risk for general anaesthesiaⁱ.

Commonest indications of shoulder arthroscopy is usually performed for Shoulder instability (recurrent dislocation of shoulder), Bankart's lesion, Supraspinatus tear, Meniscus tear, Impingement syndrome (pain on lifting the arm), Rotator cuff tears, Calcific tendonitis tendinitis (calcium deposition in the rotator cuff) and Frozen shoulder (periartthritis)ⁱⁱ.

Recent evidences, however, have increasingly focused on complications related to use of irrigation fluid, patient positioning and anaesthesia during shoulder arthroscopy. Knowledge about the mechanisms involved in these complications can result in their early detection, prevention and effective managementⁱⁱⁱ. The pressure exerted by the fluid distends the joint space, while the fluid removes any wear debris or blood found in the surgical field and keeps the soft tissues apart. Surgical procedure is performed in either beach chair position (semi-seated position similar to sitting in a reclining chair) or in lateral decubitus position^{iv, v}.

The risk of complications can be reduced with an experienced surgeon, lesser surgical duration, use of controlled pump pressures and controlled flow rate of irrigation fluids (range 40-80 mmHg and 50-150 ml/min, respectively) with continuous outflow conduit and providing general anaesthesia (airway secured) with deliberate hypotensive anaesthesia in selected patients^{vi}. The risk of airway obstruction can be anticipated and minimized by intraoperative monitoring of increased airway pressure and compliance, monitoring for increase in neck circumference post-operatively, a negative cuff leak test (absence of leak)^{vii} with endotracheal cuff deflation at end of procedure, checking for airway oedema on direct laryngoscopy or bronchoscopy and ultrasound observation of fluid infiltration^{viii}.

Material and Methods

The present prospective study involves an analysis of perioperative monitoring of effects of amount of irrigation fluid in patient undergoing shoulder arthroscopy. With objective to see the Effect of

irrigation fluid absorption on measurable parameters and to identify whether these parameters help in predicting airway/ respiratory compromise or cardiac complications. The study was approved by institutional medical ethics committee and written informed consent was obtained from all patients to be included in the study

This study was carried out in all the patients posted for shoulder arthroscopy in orthopedic O.T in Dept. of Anesthesiology at Shankaracharya Institute of Medical Sciences, Junwani, Bhilai, (CG). The sampling size in the present study was calculated based on the literature data where the fall in the post-operative haemoglobin (g/dL) levels was $(0.89 \pm 1.23, P < 0.001)$ as compared to the baseline and also the regional and systemic absorption of irrigation fluid in arthroscopic shoulder surgery as reflected in the degree of change in the measured anthropometric variables.

All the patients of any ASA Grade, sex and above 18 years who were posted for shoulder arthroscopy were included in the study. 72 patients who were undergoing shoulder arthroscopy were invited to participate in this observational study. Complete history were obtained and thorough clinical examination were carried out. All necessary investigations were noted. Brachial plexus block with general anaesthesia were given to all the patients.

Following parameters were monitored:

- Heart rate was noted every 5 minute till position was given, then every 2 minute after positioning till 10 min, then every 10 minute throughout the surgery.
- Noninvasive mean blood pressure was noted every 5 minute till position was given then every 2 minute after positioning till 10 minute, then every 10 minute throughout the surgery.
- Arrhythmia, any ST segment changes $\geq .2$ mv ST segment depression or $\geq .2$ mv ST segment elevation considered significant was noted.
- Amount of irrigation fluid (normal saline) used by surgeon was also noted and patients were divided into 4 groups depending upon the amount of irrigation fluid used (<30lit or 30-40lit or 40-50lit or >50lit).
- Preoperative and Postoperative Hemoglobin and serum electrolytes was noted.

- Leak test-Air leak around tube in spontaneously breathing patients.
- Any patient requiring post-operative ventilatory support was noted.
- Pre- and post-operative neck circumference and mid arm circumference was noted.

Data entry was done in Microsoft Excel. Data analysis was done with the help of SPSS Software version 15 & Sigma plot version 12. Quantitative data was presented with the help of Mean, Standard Deviation and Median. Comparison between study groups was done with the help of student's T test and Chi-square test. P value less than 0.05 is taken as significant level.

Results

Table 1: Demographic Variables of Patients

Demographic Variables	No. of Patients	Percentage
Age group		
20 – 29	23	31.9
30 – 39	27	37.5
40 – 49	8	11.1
50 – 59	10	13.9
60+	4	5.6
Total	72	100.0
Male	54	75
Female	18	25

The age group of patients undergoing shoulder arthroscopy is depicted in table 1. Out of 72 patients 23(31.9%) were in age group of 20-29 years, 27(37.5%) were in age group of 30-39 years, 8(11.1%) were in age group of 40-49 years, 10(13.9%) were in age group of 50-59 years and 4(5.6%) were in age group of 60 and above. Out of 72 patients 54(75%) were males and 18(25%) were females.

Table 2: Indications of shoulder arthroscopy

Clinical Variables	No. of Patients	Percentage
Indications		
Bankart lesion	34	47.2
Meniscus tear	1	1.4
Rotator cuff tear	1	1.4
Shoulder dislocation	11	15.3
Supraspinatus tear	25	34.7
Total	72	100.0

Out of 72 patients majority of patients 34(47.2%) were underwent shoulder arthroscopy for Bankart lesion, 1(1.4%) for meniscus tear, 1(1.4%) for rotator

cuff tear, 11(15.3%) for shoulder dislocation and 25(37.4%) for supraspinatus tear.

Table 3: Amount of irrigation fluid used in shoulder arthroscopy.

Variables	No. of Patients	Percentage
Amount of irrigation fluid (in litres)		
<30	47	65.3
30 – 40	24	33.3
>40	1	1.4
Total	72	100.0

30 litres or less irrigation fluid is used in 47(65.3%) patients, between 30-40 litres is used in 24(33%) patients and 40 litres or more irrigation fluid is used in 1(1.4%) patient.

Baseline pulse rate was 79.85±8.11 per minutes, which started decreasing from T4 (1.4%) to throughout the procedure and this fall was found to be statistically significant (P <0.001) using student's T-test. The maximum fall in pulse rate at 160 minutes (19.8%). Pulse rate increases from 200 minutes till the end of the surgery.

Baseline mean BP was 101.63±7.90 mm Hg, which started decreasing from T1 (16.1%) to throughout the procedure and this fall was found to be statistically significant (P <0.001) using student's T-test. The maximum fall in mean BP was at 180 minutes (34.9%). Mean BP increased from 190 minutes till the end of the surgery and was found to be statistically significant (P <0.001) using student's T-test.

Table 4: Post-Operative complications.

Variables	No. of Patients	Percentage
Delayed extubation		
Yes	4	5.6
No	68	94.4
Total	72	100.0
Leak Test		
Negative	4	5.6
Positive	68	94.4
Total	72	100.0

The leak test and delayed extubation in patients undergoing shoulder arthroscopy. Towards the end of procedure and prior to extubation 4(5.6%) patients showed negative leak test and hence, had delayed extubation, and 68(94.4%) patients showed positive

leak test and normal extubation and statistically significant ($P < 0.005$).

Out of 72 patients 4(5.6%) patients showed negative leak test and delayed extubation. Amongst these 4 patients, 3 patients received irrigation fluid of 30-40 litres and 1 patient received more than 40 litres irrigation fluid and was found to be statistically significant using Chi-square test. However, 2(2.8%) patients who showed intraoperative ECG changes received irrigation fluid of 30-40 litres and was found to be statistically non-significant using Chi-square test.

Mid arm circumference was increased by 14.2%, neck circumference was increased by 10.4%, haemoglobin (Hb) was decreased by 6.6%, serum sodium (Na) was decreased by 4.6% and serum potassium (K) was decreased by 16.2%. Post-operative changes in all these parameters was found to be statistically significant.

Discussion

Shoulder arthroscopy can be performed under general anaesthesia or regional anaesthesia. The advantage of general anaesthesia being provision of secured airway and induced hypotension with anaesthetic agents which help in reducing the amount irrigation fluid requirements. If regional anaesthesia is used as the sole anaesthetic technique, then the airway is not secured and if intra-operative airway obstruction develops, then bringing the patient to the supine position can cause delay in ultimately securing the airway. Also, neck swelling once present may limit neck mobility as well as visualization of the glottis, making laryngoscopy and intubation difficult to impossible^{ix}.

In our study the baseline heart rate was 79.85 ± 8.11 per minutes. Due to anxiety and pain of needle prick of administration of interscalene block the pulse rate at T1 (time of giving interscalene block) was increased by (3%) and it started decreasing after giving premedication drugs and general anaesthesia induction drugs (T2 and T3). After 20 minutes (T4), due to complete action of interscalene blocks and general anaesthesia drugs pulse rate reduced and became less than the baseline value by 1.4% and it decreased gradually throughout the procedure. The maximum decrease in heart rate was 19.8% from baseline at 160 minutes from the start of procedure. The minimum pulse rate was 64.00 ± 4.39 per minutes during surgery. The pulse rate started increasing at

the time of extubation. The heart rate was lower than baseline at all measuring points. Similarly, the mean BP started decreasing after giving interscalene block (T1), premedication drugs (T2) and general anaesthesia induction drugs (T3). The maximum decrease in mean BP was 34.9% from baseline at 180 minutes from the start of procedure. The minimum mean BP was 66.46 ± 6.56 mm Hg during surgery. During extubation, mean BP increased as patients were out of general anaesthesia. The mean BP was lower at all measuring points in the patients with an interscalene block. Patients were vitally stable throughout the surgery. The low heart rate and blood pressure was due to the combined effects of the interscalene block and general anaesthesia.

Similar to our study Chellamet al⁷ and Hughes et al^x found that combined interscalene block and general anaesthesia resulted in stable hemodynamic and clear surgical field in most patients.

Morrison et al.⁵ suggested that relative hypotensive anaesthesia in selected patients (adequate cerebral perfusion to be ensured), improves surgical visualization and reduces fluid extravasation into periarticular subcutaneous tissues. They also found that the safe and clear operative field can be achieved by maintaining a pressure difference of 49 mmHg between systolic blood pressure and pressure measured within the sub acromial space. However in our study facility to measure joint pressure was not available.

The irrigation fluid used for shoulder arthroscopy can get extravasated into surrounding tissues leading to soft-tissue oedema (mid arm and neck circumference) and pain. Significant increase in patient's neck and mid-arm circumferences indicating regional absorption of irrigation fluid was found in our study. The maximum increase in neck circumference which we found in one of our patient was 8 cm. A difference of 14 cm in the neck circumference was observed by Gogia AR et al⁸. The mean change in mid arm circumference and neck circumference in our study were 5.23 ± 1.48 cm and 3.86 ± 1.33 cm respectively. The percentage increase in mid arm circumference and neck circumference from pre-operative values was 14.2% and 10.4% respectively.

The maximum increase in neck circumference found by Surbhi et al^{xi} in one of the patient was 6.5 cm. In their study the mean increase in mid arm circumference and neck circumference from pre-

operative values were 3.28 ± 2.44 cm and 2.35 ± 1.90 cm respectively. Chellamet al⁷ suggested that airway compromise occurs when the neck circumference increases by more than 4 cm from pre-operative value. Hynsonet al¹. reported extra-articular dissection of arthroscopic irrigation solution causing complete airway obstruction and even suggested monitoring of neck circumference throughout the procedure. Sharma M et al^{xii} found a unique case of extensive soft-tissue oedema spreading across the midline across the neck, upper chest soft-tissue involving the airway mucosa due to the leakage of irrigation fluid. AntonucciS et al² found that two cases of airway obstruction as a result of oedema of laryngeal structures which arose during protracted arthroscopic shoulder surgery due to extra-articular leakage of fluid. Edwards *et al*^{xiii}. have reported a rare case of an anatomical variant with abnormal communication amongst the shoulder joint, infrapinnous fossa, thorax and neck leading to massive airway oedema and obstruction.

The six contributing factors responsible for airway oedema like sub-acromial procedures, prolonged duration of surgery, high pump pressures (beyond 150 mm of Hg), intraoperative hypertension, loose connective tissue around the neck and lateral decubitus position^{1, xiv} have been reported. In our study, we also found that irrigation of fluid, duration of surgery, intraoperative hypotension, age above 50 years and lateral decubitus position were associated with airway oedema and mid arm circumference. In our study we did not observe any patient suffering from tracheal compression by the extravasation of irrigation fluid or respiratory compromise in shoulder arthroscopy such as air embolism.

In our study, we found the positive correlation between the decrease in serum sodium and potassium levels with the duration of surgery and the amount of irrigation fluid used. We observed that serum sodium (Na) was decreased by 4.6% and serum potassium (K) was decreased by 16.2%. Surbhiet al¹¹ also reported that use of excess irrigation fluid may result in acid base and electrolyte imbalance which may be harmful to the patients.

Conclusion

Extravasation of irrigation fluid used during shoulder arthroscopy can be disastrous leading to various complications like airway oedema, tracheal compression extensive subcutaneous emphysema, pneumomediastinum, tension pneumothorax and air

embolism. The advantages of shoulder arthroscopy include small incisions, decreased postoperative morbidity, and potentially faster rehabilitation. The risk of regional and systemic absorption of irrigation fluid is directly proportional to amount of irrigation fluid used and duration of surgery. The measurement of neck circumference can be a clinical predictor for airway oedema following shoulder arthroscopy. We recommend withholding extubation when the neck circumference increases by more than 6 cm. High degree of clinical suspicion of airway oedema is required in the early postoperative period.

References

1. Hynson JA, Tung A, Jason EG, Jeffery AK, James MG, William AS. Complete airway obstruction during arthroscopic shoulder surgery. *AnesthAnalg* 1993; 76:875-8.
2. Antonucci S, Orlandi P, Mattei PA, Amato F. Airway obstruction during arthroscopic shoulder surgery: Anesthesia for the patient or for the surgeon? *Minerva Anestesiol.* 2006;72:995-1000.
3. Orebaugh SL. Life-threatening airway oedema resulting from prolonged shoulder arthroscopy. *Anesthesiology.* 2003;99:1456-8.
4. Venkat G, Moon YL, Na WC, So KY. Upper airway compromise by extravasated fluid: A rare complication after arthroscopic repair of atrophic cuff tear. *Orthopedics.* 2009:32.
5. Morrison DS, Schaefer RK, Freidman RL. The relationship between subacromial space pressure, blood pressure, and visual clarity during arthroscopic subacromial decompression. *Arthroscopy.* 1995; 11:557-60.
6. Manjuladevi M, Gupta S, Upadhyaya KV, Kutappa AM. Postoperative airway compromise in shoulder arthroscopy: A case series. *Indian J Anaesth* 2013; 57:52-5
7. Chellam S, Chiplonkar S, Pathak K. Change in neck circumference after shoulder arthroscopy: An observational study. *Indian J Anaesth* 2015;59:365-8.
8. Gogia AR, Bajaj J, Sahni A, Saigal D. Negative-pressure pulmonary oedema in a patient undergoing shoulder arthroscopy. *Indian J Anaesth.* 2012;56:62-5.
9. Blumenthal S, Nadig M, Gerber C, Borgeat A. Severe airway obstruction during arthroscopic shoulder surgery. *Anesthesiology.* 2003;99:1455-6.
10. Hughes MS, Matava MJ, Wright RW, Brophy RH, Smith MV. Interscalene brachial plexus block for arthroscopic shoulder surgery: A systematic review. *J Bone Joint Surg Am* 2013;95:1318-24.
11. Surbhi Gupta, M Manjuladevi, KS Vasudeva Upadhyaya, AM Kutappa, Rajkumar Amaravathi, JArpana. Effects of irrigation fluid in shoulder

arthroscopy. Year: 2016, Volume: 60, Issue: 3, Page: 194-198

12. Sharma M, Achar SK. Airway oedema during shoulder arthroscopy: How we played it safe! *Indian J Anaesth.* 2013;57:319–20.
13. Edwards DS, Davis I, Jones NA, Simon DW. Rapid tracheal deviation and airway compromise due to fluid extravasation during shoulder arthroscopy. *J Shoulder Elbow Surg* 2014;23:e163-5.
14. Borgeat A, Bird P, Ekatodramis G, Dumont C. Tracheal compression caused by periarticular fluid accumulation: A rare complication of shoulder surgery. *J Shoulder Elbow Surg.* 2000;9:443–5.