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Clinical Observation of Wound Fluid Extravasation after Shoulder Arthroscopy

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Abstract: ***Fluid leakage to the outside of the wound after shoulder arthroscopy can present a risk of complications such as wound infection and delayed wound healing. Most relevant studies dealt with fluid leakage to the internal environment and did not focus on fluid leakage outside the body and its effect on the wound. We, therefore, focused on and investigated the significance of wound fluid leakage to the body surface after shoulder arthroscopy. Methods: Observational and analyzed patient data from 15 cases of shoulder arthroscopy were used to calculate the amount of fluid exudation by recording the operation time, the amount of intraoperative fluid perfusion, the surgical incisions, and weighing the surgical dressings on the first day of the postoperative period. The statistical method of Pearson's correlation coefficient was used to evaluate the correlation between the patients' postoperative fluid exudate volume and the operation time, intraoperative fluid infusion volume, and surgical incision. Results: All patients had no incision infections or other postoperative complications. The duration of surgery and the amount of postoperative wound exudate were correlated in 15 patients (R=.547, p<.05), the amount of perfusion and the amount of postoperative wound exudate were statistically significant (R=.569, p<.05), and the incisions and the amount of postoperative wound exudate were statistically significant (R=.702, p<.05). Conclusion: There is a correlation between postoperative fluid exudation after shoulder arthroscopy and operative time, intraoperative perfusion, and surgical incisions. When the operator performs shoulder arthroscopy, he or she should try to shorten the operative time and reduce intraoperative fluid perfusion and surgical incisions.***

Keywords: Shoulder arthroscopy, Wound, Dressing, Fluid, Extravasation**.**

1. Introduction

Arthroscopic surgery can be performed on all large and a few small joints, and most procedures require continuous saline perfusion with adequate hydration to obtain adequate surgical field. However, large amounts of fluid perfusion may lead to local fluid retention with potentially dangerous complications such as neck, face, chest, and airway injuries and central nervous system damage reported significant complication rates ranging from 0.56-8.2%, but fluid extravasation can lead to edema of the surrounding tissues and produce respiratory depression, which may even lead to death in severe cases [1][2][3][4].

Compared to conventional surgery, arthroscopic surgery is minimally invasive and usually involves several 2-5mm skin incisions. Postoperatively, complications of surgical incisions usually affect the entire recovery process, and common complications include swelling, blisters, ecchymosis, infection, poor healing, and postoperative wound exudate in the surgical area. In contrast, the incision complication rate is more than 10% in trauma-type surgeries [5]. Post-surgical wound exudate refers to the liquid component of fluid from the capillaries into the body's tissues; exudate is a component of the main water but also includes nutrients, proteins, inflammatory mediators, growth factors, metabolites, etc. Exudate plays an essential role in wound healing, but too much fluid is detrimental to the healing of the surgical incision [6][7]. Common causes of incisional fluid exudation include excessive pulling of soft tissues during surgery, early infection, poor incision healing, large amounts of intraoperative irrigation fluid, and ischemia and reperfusion of the body after tourniquet application [8][9]. Due to the large amount of fluid irrigation used in arthroscopy, postoperative wound exudation is significantly greater than in conventional surgery and increases the risk of complications associated with excessive wound exudation.

At the end of a surgical procedure, the surgeon in charge usually closes and dresses the surgical incision to facilitate healing and prevent infection. Wound dressing changes are carried out to keep the incision clean, remove exudate, and isolate bacteria, thus keeping the area around the incision dry. To prevent the occurrence of SSIs (surgical wound infections), the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom has made recommendations for postoperative wound management, including dressing changes and wound cleansing, antibiotic treatment for SSIs, debridement, and specialized wound care services [10].

In previous studies, the main research direction of fluid extravasation after arthroscopic surgery was fluid infiltration into the tissues surrounding the surgical area. When the perfusion volume is ≥20L, the irrigation fluid is retained in the tissues of the surgical site, infiltrates into the neck and chest, and infiltrates into the paratracheal space and the carotid space through the tissue space in the neck, leading to tracheal compression or even respiratory obstruction [11]; the edema of thoracic cavity tissues can affect respiratory auxiliary muscle groups and thoracic compliance, which reduces the arc of respiratory movement and causes hypoxemia; the pleural cavity or interstitium of the lungs can also be infiltrated with irrigation fluid [12], so that the exchange function of the lungs is limited, leading to postoperative respiratory obstruction and hypoxemia, which causes hypoxia, and can even cause pleural effusion and pulmonary edema, endangering the patient's life safety. There are fewer studies on the leakage of perfused fluid from the wound to the body surface and its effect on patients. Therefore, we analyzed the data of 15 patients who underwent shoulder arthroscopy in the

Department of Sports Medicine of the First Affiliated Hospital of Guizhou University of Traditional Chinese Medicine from Jan 1, 2023, to Dec 31, 2023, intending to observe the exudation of perfusion fluid from the incision to the body surface and the impact on the patients after the patients underwent shoulder arthroscopy.

2. Methods

Institutional review board approval was obtained for the study protocol, and all procedures complied with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from all patients.

2.1 Study Population and In-/exclusion Criteria

To observe and analyze the dressings and general data of patients in the first dressing change of the wounds of 17 patients after shoulder arthroscopy surgery treatment in the Department of Sports Medicine of the First Affiliated Hospital of Guizhou University of Traditional Chinese Medicine from Jan 1, 2023, to Dec 31, 2023.

Inclusion criteria: 1) arthroscopic shoulder joint exploration surgery was performed; 2) surgery was operated by the same attending surgeon; 3) intraoperative perfusion fluid was sterile saline + 0.1% epinephrine injection; 4) postoperatively, all of them were wrapped with the same type of five-layered sterile dressings and covered with disposable sterile surgical films.

Exclusion criteria: 1) injection of other drugs into the perfusion solution, 2) insufficient postoperative wound cover dressing.

Based on the inclusion and exclusion criteria, two of the 17 patients were excluded from the study due to the negligence of the housekeeping team, which resulted in four layers of postoperative overlay dressings; ultimately, 15 patients were included in the study, for which written informed consent for the use of medical records was obtained from all patients.

2.2 Materials

medical degreasing gauze block (Henan Anbang sanitary material, 20*13cm, executive standard: YYT 0594-2024) to cover and dress the wound; single-use sterile surgical film (Henan Anbang sanitary material, 30*45cm, executive standard: YYT 0825-2023) to cover and fix it; use LICHEN LC-SJA2003 precision electronic weighing scale (LICHEN TECHNOLOGY. Model: JA2003, precision ±0.005, implementation standard: GB/T 26497-2022) for dressing weighing.

All 15 patients used the exact specification of gauze dressing, five layers of wound covering and bandaging after surgery, and the exact specification of disposable sterile surgical film to cover and fix the wound externally, and all the operations were performed by the same group of physicians.

2.3 Surgical Technique

all surgeries were performed by the same senior surgeon. All patients were placed in the beach chair position, anesthesia was epidural nerve block, and intraoperative fluctuation of the patient's blood pressure was controlled at 100-100/60-80 mm Hg. The surgeon established surgical access based on preoperative planning and intraoperative exploration findings and managed the shoulder joint lesions, including synovial cleaning of the shoulder joint, glenoid labral repair, acromion shaping, rotator cuff cleaning repair, etc. The intraoperative fluid instillation was 3000 ml of sodium chloride solution + 0.1% epinephrine 1 ml, and the radiofrequency planer knife system was used for hemostasis during the operation. At the end of the operation, five layers of sterile dressings were used for bandaging, and the disposable sterile surgical film was used for covering and fixing the amount of saline infusion; the surgical incisions and the operation time were recorded during the operation.

2.4 Weighing Method and Liquid Volume Calculation

1) Take the same brand, specifications, and batch number of gauze block five layers for dry dressing weighing; 2) The next day after the operation, remove the postoperative coverage of wet gauze block five layers and remove the disposable sterile surgical film for weighing. The mass of postoperative moist dressing weighed minus the mass of dry dressing is the mass of wound extravasated fluid.

2.5 Statistics

data were processed using IBM SPSS 26.0 statistical software. Count data were described by frequency analysis, and measure data were described by mean ± standard deviation (x±s) if they conformed to normal distribution and by median and quartiles if they did not conform to normal distribution. For the one-way analysis section, Pearson's correlation analysis was used if the data conformed to normal distribution and were all measures, and Spearman's correlation analysis was used if the data did not conform to normal distribution and were all measures. Independent samples t-test or one-way ANOVA was used if the data were measures and counts and the measures were normally distributed, and Mann-Whitney test or Kruskal-Wallis test was used if the data were measures and counts and the measures were not normally distributed.

3. Results

All patients had no postoperative infections or other complications. The mean age at surgery for the 15 patients was 60 years (SD ± 7.49, range 46-74). There were five males (33.33%) and ten females (66.67%), seven left shoulders (46.67%) and eight right shoulders (53.33%). (Table 1).

The mean operative time was 108.27 minutes (SD ± 42.37, range, 60-230 minutes); the mean perfusion volume was 18,000 ml (SD ± 6,000, range, 6,000-30,000 ml); the mean exudate volume was 80.88 ml (SD ± 41.90, range, 37-169 ml); and the mean incisions was 3.87 (SD ± 0.64, range, 3-5) (Table 2).

Surgical time correlated with postoperative wound exudate volume ($R=.547$, $p<.05$), perfusion volume correlated with postoperative wound exudate volume ($R=.569$, $p<.05$), and incisions correlated with postoperative wound exudate

volume (R=.7.02 p<.05) (Table 3).

Table 1: General information of patients.

		Frequency	percent (%)	Cumulative percentage (%)
Sex	Male	5	33.33	33.33
	Female	10	66.67	100.00
Surgical area	Left	7	46.67	46.67
	Right	8	53.33	100.00
Sum		15	100.0	100.0

Table 2: Patient information on duration of surgery, perfusion volume, incisions, and exudate volume.

	Min	Max	Mean ± standard deviation	Median M (P25, P75)
Age(years)	46.00	74.00	60.00±7.49	59.00(54.0,56.0)
Operating time (Min)	60.00	230.00	108.27±42.37	100.00(85.0,110.0)
Perfusion (ML)	6000.00	30000.00	18000.00±6000.00	18000.00(15000.0,21000.0)
Incisions (Pcs)	3.00	5.00	3.87±0.64	4.00(3.0,4.0)
Permeate (ML)	37.00	169.00	80.88±41.90	62.70(50.9,107.5)

Table 3: Comparison between patients' operative time, perfusion volume, incisions, and exudate volume.

Observation indicators \ Permeate	r/H	p
Operating time	0.547	0.035
Perfusion	0.569	0.027
Incisions	0.702	0.004

Pearson's correlation coefficient was used to analyze the relationship between exudate volume and operative time, perfusion volume, incisions, and underlying disease, and a significant correlation existed between the two when the result was greater than 0.5, and the two-tailed test was less than 0.05.

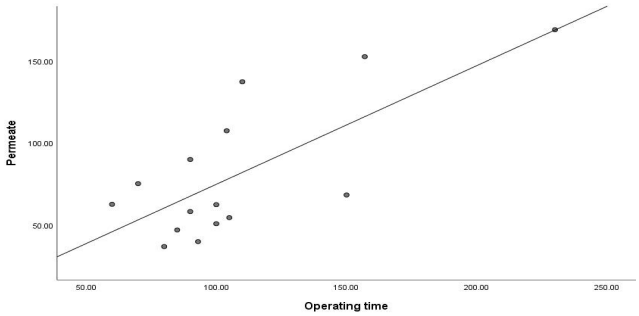

Figure 1: The correlation between surgery time and exudate volume.

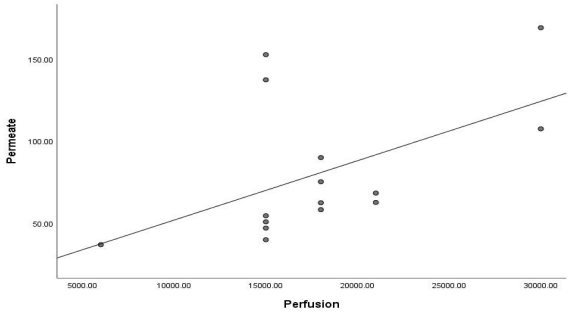

Figure 2: The correlation between perfusion volume and exudate volume.

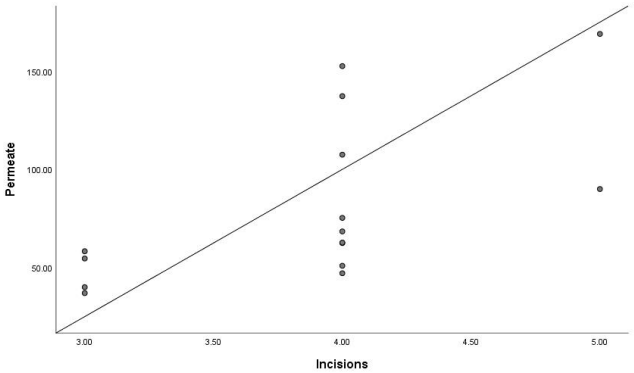

Figure 3: The correlation between the surgical incisions and exudate volume

4. Discussion

This study showed that in patients undergoing shoulder arthroscopy, the amount of wound exudate significantly correlated with the duration of surgery, intraoperative perfusion, and the number of surgical incisions.

The surgeon's goal for surgical wounds is to optimize the wound healing environment and prevent complications such as blisters and surgical site infections; therefore, dressings play a crucial role in postoperative wound care. The expert consensus of the World Society of Wound Healing recognizes that managing exudate through wound dressings is particularly important. Wet exudate may be associated with the risk of infection, skin colony migration, and wound tearing and can delay wound healing [13]. The level of postoperative wound exudate depends to some extent on the type of surgery performed, and in arthroscopic surgery, due to a large amount of intraoperative fluid perfusion, fluid retention makes the postoperative wound exude a large amount of fluid, and wetting the dressing can potentially increase the risk of infection. Wounds provide the conditions for the skin surface microorganisms that make up the skin microbiota and microorganisms from the environment to access the deeper tissues and provide optimal conditions for bacterial colonization and growth [14]. Before the surgical incision has healed, the deeper part of the operative area is left open to the body surface, providing pathways for pathogenic microorganisms to migrate from the surface to the deeper part of the body, and there are risk factors for infection. Stone et al. [15] concluded that more than 50 percent of the patients with deep infections after rotator cuff repair required multiple debridements and also that chronic infections portend poorer functional outcomes. Our follow-up found that none of the patients experienced infection complications. There are several ways to prevent postoperative surgical site infections, such as strict hand disinfection, preoperative antibiotics, and strict asepsis. The World Health Organisation recommends preoperative skin disinfection as one of the critical factors in postoperative surgical site infections [16]. At the time of surgery, we used a povidone-iodine solution for mass disinfection of the shoulder joint surgical area within 15 cm of the surgical approach. Povidone-iodine can form a layer of skin barrier at the surgical site, exerting a sustained bacteriostatic effect; secondly, we carried out the dressing change of the wound site on the first day of the postoperative period, which was not more than within an average time of 12 hours, eliminating the environment for bacterial growth under

the wet dressing.

Although there is no exact upper limit to the amount of irrigation fluid that can be used during shoulder arthroscopy, Memon et al. [9] concluded that the average fluid perfusion volume during shoulder arthroscopy is approximately 20-36L, with a volume below 20L of perfusion being considered a safe threshold. In that study, a perfusion volume of 6L-10L was used, and no adverse effects were reported in the patients postoperatively. After shoulder arthroscopy examination, fluid retention in the affected limb of the patient will leak outward into the body, leading to swelling of the shoulder joint, which becomes the most common complication after arthroscopic shoulder surgery.

The amount of fluid leaking outward is directly proportional to the duration of surgery, and at an average perfusion volume of 20-36 L, this corresponds to a surgical time of 90-180 minutes. In the present study, the operative time ranged from 60-230 minutes, corresponding to 6-10 L perfusion volumes, indicating a significant correlation between operative time and postoperative wound exudate volume. Studies have suggested that shoulder arthroscopy should be limited to 90-120 minutes to reduce the risk of complications, and in the majority of cases where complications occurred, the operative time exceeded 180 minutes [9][17].

Swelling of the affected shoulder usually occurs after shoulder arthroscopy due to extra-tissue leakage of fluid, and the surgical incision selected by the operator as an observation and manipulation access can be used as a drainage port for postoperative fluid retention. In this study, the incisions ranged from 3 to 5, and the results between the incisions and the amount of fluid exuded showed a correlation between the surgical incisions and the amount of fluid exuded in the postoperative period our study demonstrated that more incisions were taken at the time of the operation were associated with an increase in the amount of fluid exuded in the postoperative period.

Conclusion

After arthroscopic surgery of the shoulder joint, a large amount of fluid is commonly retained in the shoulder joint, and the amount of fluid retained is related to the duration of the surgery, the amount of fluid instilled, and the surgical incisions made. Postoperative dressings usually become wet due to the drainage of large amounts of fluid, which creates conditions for bacterial transplantation and growth. We suggest that surgeons try to shorten the duration of surgery, reduce the amount of intraoperative fluid infusion, and change the dressings when they become wet to reduce surgical complications.

Limitation

Regarding the limitations of this study, firstly, as the intraoperative perfusion volume would primarily drain out in the postoperative period, we failed to count the specific amount of drainage and postoperative fluid retention throughout the operation, and bias may occur in the final statistical results. Secondly, we did not count the time between the patient's postoperative period and the first dressing change. In the study, when the amount of exudate is large, the wound dressing will be extensively infiltrated, and the tube bed group will change the wound to a dry and clean dressing at the first time, thus correlating with the correlation between the amount of fluid retention and the amount of drainage in the postoperative period. Since this study has some limitations as a prospective study, we will remedy these shortcomings in subsequent studies. Despite these limitations, our study revealed a relationship between fluid retention during shoulder arthroscopy and the amount of postoperative wound exudate.

Conflict of Interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

L Liu was the lead author of this manuscript. L Liu, S Zhao, S Ding and Y Ni jointly designed and performed experiments, analyzed data, and L Liu wrote the first draft. L Liu and D Yang performed the clinical examination and analyzed and interpreted the patient data. All authors read and approved the final draft.

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Ethics Approval and Consent to Participate

The study protocol was approved by the Institutional Review Board and all procedures complied with the 1964 Declaration of Helsinki and its subsequent amendments or similar ethical standards. All personnel gave informed consent to participate in the study and approval was obtained from the Medical Research Ethics Committee of the First Affiliated Hospital of Guizhou University of Traditional Chinese Medicine.

Availability of Data and Materials

Not applicable.

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