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Hemostasis: A Comparative Analysis of Hot Saline and Room Temperature Saline in Sinus Surgery

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ABSTRACT

Objective: To evaluate the efficacy of room temperature Saline irrigation (RTSI) and hot Saline irrigation (HSI) in controlling intraoperative bleeding during functional endoscopic sinus surgery (FESS).

Study Design: Quasi-experimental study

Place and Duration of Study: Department of Otorhinolaryngology, Combined Military Hospital, Rawalpindi, Pakistan from Jul 2000 to Dec 2022.

Methodology: Sixty-two patients with chronic rhinosinusitis undergoing functional endoscopic sinus surgery were randomly assigned to two treatment Groups. One Group received 20 mL of 50°C Saline irrigation, and the other received 20 mL of 18°C Saline irrigation, administered every 10 minutes during the procedure. The study assessed the intraoperative bleeding score, average arterial pressure, and duration of the surgical procedure.

Results: The Boezaart endoscopic field of view score was significantly better in the Group that received 49°C Saline Group (Median (IQR)= 3.00 (3.00-2.00)) compared to the Group that received 18°C Saline Group (Median(IQR)= 2.00(2.00-1.00)), with a statistically significant p-value of 0.003. Additionally, the operating time was notably shorter in the 49°C Saline Group (114.29 ± 14.86 minutes) as compared to the 18°C Saline Group (124.48 ± 15.13 minutes), with a p-value of 0.010. Total blood loss was significantly lower in the 49°C Saline Group (Median (IQR)= 258.00 (278.00 – 224.00)) compared to the 18°C Saline Group (Median(IQR)= 221 (254.00 – 200.00)), with a *p*-value of 0.008.

Conclusion: Intranasal hot Saline irrigation during functional endoscopic sinus surgery reduces blood loss, shortens operative time, and enhances the quality of the surgical field without affecting intraoperative hemodynamic stability.

Keywords: Functional endoscopic sinus surgery (FESS), hemostasis, hot Saline irrigation (HSI), and intraoperative blood loss.

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INTRODUCTION

For functional endoscopic sinus surgery (FESS), a bloodless operating area that permits smooth dissection in a reasonably short amount of time and helps to prevent severe problems is ideal.[1] Chronic rhinosinusitis (CRS) is treated with this surgical technique. There is no denying its undeniable benefits over traditional sinonasal surgery. These benefits include reduced damage to the sinonasal mucosa, prevention of facial scars, the use of precise techniques, improved visualization, fewer complications, better outcomes, and shorter recovery times and hospital stays.[1,2] To enhance the surgical environment during functional endoscopic sinus surgery (FESS), various techniques have been employed. Common methods include intraoperative packing with topical vasoconstrictors, induced hypotension, and the use of bipolar diathermy. Despite their effectiveness, concerns about safety and potential adverse effects remain. Topical vasoconstrictors have been linked to adverse effects on hemodynamic stability, including oxymetazoline, cocaine, and epinephrine. These should be used with caution, particularly in patients with a history of hypertension or ischemic heart disease, as well as in pediatric cases.[3] Diathermy used before and after nasal surgery was linked to increased discomfort, delayed bleeding, and damage to the nasal mucosa.[4] We can use a hypotensive technique if we have the expertise of the anesthetist. Hypotensive technique also depends upon the use of anesthetic drugs and higher risk of potential adverse effects.[5] The drawbacks mentioned above necessitate the use of a different strategy for hemostasis control.The most common use of intranasal hot Saline irrigation is to treat epistaxis.[6] It was discovered that Saline irrigation for epistaxis was simpler, more comfortable, and less disruptive to the nose than nasal packing.[7] Furthermore, it has been demonstrated that irrigation with hot Saline between 39 and 49 °C reduces cerebral bleeding from tiny veins as well as diffuse seeping from the sinonasal mucosa.[7] Saline irrigation provides the added benefit of clearing the endoscopic lens when it becomes obscured by bleeding. The hemostatic effect associated with hot

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Saline irrigation may not be immediately apparent. It could be due to mucosal edema, which exerts pressure on the injured vessel, thereby reducing blood flow (tamponade effect). Additionally, it is believed that hot Saline irrigation quickens the body's clotting cascade mechanism, which helps to stop bleeding.8 During functional endoscopic sinus surgery (FESS), the irrigation with intranasal hot Saline is intended to decrease blood loss, improve the quality of the surgical field, and decrease the time of operation.

METHODOLOGY

The quasi-experimental study was conducted at Department of Otorhinolaryngology, Combined Military Hospital, Rawalpindi, Pakistan from July 2020 and December 2022, after approval from the Institutional Ethics Review Board (IERB number 539).A total of sixty-eight patients diagnosed with chronic rhinosinusitis (CRS) were initially considered, but only sixty-two were enrolled. The sample size was calculated using the WHO sample size calculator, with the mean Boezaart endoscopic field of view score after 18°C Saline irrigation as 2.68±0.97 and after 50°C Saline irrigation as 1.94 ± 0.81.[9] The estimated sample size was determined to be 62 patients, with 31 patients in each Group.

Inclusion Criteria: Participants aged 19 years and older with an American Society of Anesthesiologists (ASA) classification of less than II, suffering from recurrent or chronic rhinosinusitis, with or without nasal polyposis, and resistant to medical treatment, were included.

Exclusion Criteria: Patients with severe ischemic heart disease (IHD), lung diseases, renal disorders, bleeding or coagulation disorders, tumors, vascular anomalies, cystic fibrosis, allergic fungal sinusitis, Wegener's granulomatosis, and those unable to speak, read, or write in English.

Prior to surgery, all patients underwent a CT scan. Random assignment to the Intervention Groups (18 degree Celsius or 50 degree Celsius Saline irrigation) was done using a closed-envelope method. Anesthesia was administered using intravenous propofol followed by inhaled desflurane, remifentanil, and propofol infusion to maintain mean arterial blood pressure at 75 mmHg. Intubation and nasal packing with Xynosine and adrenaline-soaked neuro-patties were performed to minimize blood flow. Patients were positioned in the reverse Trendelenburg position with a 15-degree head elevation.

Saline irrigation was administered every ten minutes during surgery using a medical-grade fluid warmer to maintain the designated temperature. The operation theatre assistant adjusted the warmer's temperature based on the treatment allocation card, kept secret from the surgeon. The Boezaart endoscopic field of view score (0 to 5) was used to assess intraoperative bleeding.

Intranasal hot Saline irrigation during functional endoscopic sinus surgery reduces blood loss, shortens operative time, and enhances the quality of the surgical field without affecting intraoperative hemodynamic stability.

Before surgery, all patients who were booked for functional endoscopic sinus surgery had a CT scan. Using a closed-envelope method, 62 patients were randomly assigned in equal ratios to each intervention Group (Saline irrigation at 18°C or 50°C). Each intervention Group consisted of thirty-one patients. The patients were not informed about the temperature of the Saline irrigation they would receive during the surgical procedure (Figure).

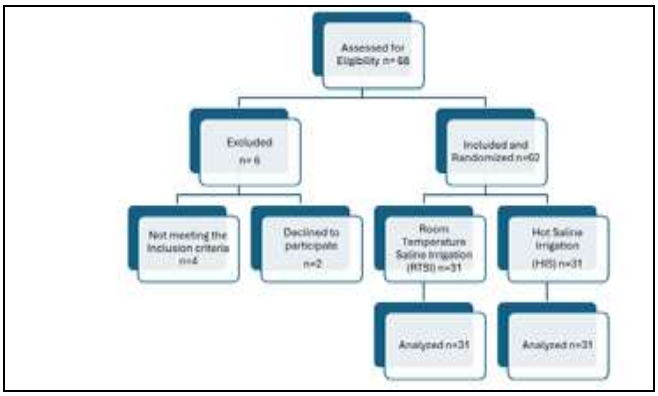

Figure: CONSORT Flow Diagram of Participant Enrollment

In order to maintain mean arterial blood pressure at 75 mmHg, patients who had received intravenous Propofol were placed under general anesthesia using inhaled Desflurane, Remifentanil, and Propofol infusion. Intubation followed by nasal packing with Xynosine and Adrenaline-soaked neuro-patties aimed at minimizing blood flow into the airway. Positioning in RTP with a 15-degree head elevation completed the anesthesia protocol.

The Saline irrigation solution was kept at a constant temperature using a medical-grade fluid warmer. The warmer's temperature was changed by the operation theatre assistant (OTA) using the treatment allocation card, which was kept a secret

from the surgeon and indicated either 18°C or 50°C Saline. During sinus surgery, Saline irrigation was verified endoscopically every ten minutes.[10] This is a scale from 0 to 5 that indicates how much suction is needed to remove the blood that is obstructing the view. A score of 0 indicated no bleeding, 1 represented minor bleeding that did not require suction, 2 indicated minor bleeding that required suction, 3 represented moderate bleeding that improved briefly after suction, 4 indicated that moderate bleeding resumed immediately after aspiration, and 5 indicated severe bleeding that occurred more rapidly than it could be controlled.

Data was analyzed using the Statistical Package for the Social Sciences (SPSS) 22.00. Normality of data was checked by using the Kolmogorov-Smirnov test. Age and operative time were normally distributed, represented by Mean±Sd deviation (SD). In contrast, total blood loss (mL) was not normally distributed and was represented using median (IQR). Qualitative data (gender) were represented using percentages and frequencies. Chi square test (for qualitative variables), Mann-Whitney U-test (for non-normal quantitative data and Boezaart endoscopic field), and independent sample t-test (for normally distributed quantitative data) were applied, and a *p*-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 68 patients diagnosed with chronic rhinosinusitis (CRS) were initially considered, of which 62 were enrolled in the study. The mean age of the 18°C Saline Group was 36.48±9.74 years, and the 49°C Saline Group was38.87±8.91 years. The demographic details are shown in Table-I.

Table-I: Demographic Characteristics of the Study Participants (n=62)

Parameters	18°C Saline Group (n = 31)	49°C Saline Group (n = 31)
Age (Years) Mean±SD	36.48±9.74	38.87±8.91
Males	19(44%)	25(56%)
Females	12(66%)	6(34%)

Irrigation at 18°C versus 49°C during Functional Endoscopic Sinus Surgery

Table-II shows that, The Boezaart endoscopic field of view score was significantly better in the Group that received 49°C Saline (Median(IQR)= 3.00(3.00-2.00)) compared to the Group that received 18°C Saline (Median(IQR)= 2.00(2.00-1.00)), with a statistically significant *p*-value of 0.003. Additionally, the operating time was notably shorter in the 49°C Saline Group (114.29±14.86 minutes) as compared to the 18°C Saline Group (124.48±15.13 minutes), with a *p*-value of 0.010. Total blood loss was significantly lower in the 49°C Saline Group (Median (IQR)= 258.00 (278.00 – 224.000)) compared to the 18°C Saline Group (Median(IQR)= 221.00 (254.00 – 200.00)), with a *p*-value of 0.008.

Table-II: Comparison of Boezaart Endoscopic Field, Operating Time and Blood Loss among the Groups (n=62)

Parameters	18°C Saline Group (n = 31)	49°C Saline Group (n = 31)	*p*-Value
Boezaart Endoscopic Field Median (IQR)	3.00(3.00-2.00)	2.00(2.00-1.00)	0.003
Total Blood Loss (mL) Median (IQR)	258.00 (278.00 – 224.000)	221 (254.00 – 200.00)	0.008
Operating time (minutes) Mean ± SD	134.48±15.12	114.29±2.67	0.010

Irrigation at 18°C versus 49°C during Functional Endoscopic Sinus Surgery

DISCUSSION

More than a century ago, obstetricians used hot water irrigation (HWI) to treat postpartum hemorrhage.[11] In 1878, Guice and Fayette pioneered its use for intractable epistaxis, and Stangerup and Thomsen explored its hemostatic effects in a rabbit study.[12] They discovered that HWI at temperatures between 48°C and 52°C induced mucosal edema, potentially compressing bleeding vessels and initiating the clotting cascade. Human trials, including one by Stangerup *et al.*, demonstrated HWI's effectiveness in posterior epistaxis, resulting in shorter hospital stays and less pain compared to standard tamponade treatment.[13] HWI was recommended for use in outpatient settings as a first-line treatment for posterior epistaxis, following a study conducted in 2006 that reported an eighty-two percent success rate with the treatment.[14]

A meta-analysis was conducted in 2022 by Nagarajah *et al.*, our results are according with the previous studies conducted at different setups.[15] Our study found that the overall blood score (BS) was 1.94 for patients receiving 50°C Saline and 2.68 for those receiving 18°C Saline, with this difference being statistically significant. The use of hot Saline irrigation

(HSI) may improve visualization during FESS, particularly in cases expected to last longer than two hours, such as those involving complex anatomy of the sinus, sinonasal tumors, or bleeding disorders. Furthermore, the 50°C Group experienced considerably less total estimated blood loss than the 18°C Group. Overall, the utilization of HSI contributed to a reduction in blood loss.

There were a few limitations in our study. Despite randomization, patients with nasal polyposis and CRS have been found to have worse bleeding and a view of the surgical field because of increased vascularity and inflammation in these patients.[16-18] We used both subjective measures and objective measures to evaluate intraoperative blood loss during FESS. Because the surgical field of view scores are based on the subjective opinion of the surgeon, bias and experimental error may occur. Both patients and surgeons were kept in the dark about the temperature of the Saline during surgery in order to reduce bias. This kept information about the experimental Group from impacting the surgeon's evaluation of the operative field. An additional non-operating surgeon, who was blinded to the treatment, collaborated with the operating surgeon to determine the average bleeding score (BS) to ensure consistency in the scoring. The entire volume of aspirated fluid (which contained both irrigation Saline and blood) upon procedure completion was subtracted from the total amount of irrigation fluid utilized throughout surgery to determine the overall blood loss. The possible failure to account for fluids that the suction container did not gather is a drawback of this computation technique. In order to reduce this error during irrigation, the suction tube was firmly wrapped around the nostril, and a sponge was inserted into the back of the nasopharynx. We were unable to maintain the irrigation fluid's temperature at 50°C throughout the procedure.

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CONCLUSION

Performing intranasal hot Saline irrigation (HSI) during functional endoscopic sinus surgery (FESS) proves advantageous in managing intraoperative bleeding and enhancing the quality of the surgical field. This practice decreases blood loss, reduces operative time, and does not impact intraoperative hemodynamic stability.

Conflict of Interest: None.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MGK & MR: Data acquisition, data analysis, critical review, approval of the final version to be published.

JAA & SSUW: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

NJ & WH: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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