ORIGINAL ARTICLE

THE EFFECT OF SUBCUTANEOUS EPINEPHRINE DOSAGE ON BLOOD LOSS IN SURGICAL INCISION

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Background: Vasoconstrictive drugs are increasingly frequently used to stop bleeding during cosmetic and reconstructive surgeries, especially subcutaneous epinephrine. As far as we are aware, no studies have been conducted on how adrenaline affects bleeding in patients having supraventricular flap surgery so we planned this study to find out the impact of various epinephrine dosages on the amount of bleeding in surgical incisions among participants undergoing supraclavicular flap surgery. **Methods:** This single-blinded randomised controlled trial was performed at the Department of Plastic Surgery, Ruth Pfau Civil Hospital, from September 2022 to September 2023. Group 1 was given 0.9% saline with an epinephrine concentration of 1:200,000. Group 2 was administered a 0.9% saline solution containing a 1:400,000 epinephrine concentration. Group 3 was given just 10 ml of 0.9 % saline (control group). Bleeding was measured for 5 minutes by volumetric method. **Results:** Patients' age (p=0.221), gender (p=1.000) and surgery site (p=0.265) were not significantly different among the three study groups. Mean blood loss volume for group 1, group 2 and group 3 was 15.8 0±5.37mL, 19.80±8.44mL and 57.20±14.14mL respectively. On post-hoc analysis for total blood loss volume, significant differences were seen between Group 1 and Group 3 (p<0.001), and Group 2 and Group 3 (p<0.001). **Conclusion:** The present study showed that blood loss was significantly lower among both of the groups of adrenalines but blood loss from the two doses of epinephrine did not differ significantly.

Keywords: Supraclavicular flap, Epinephrine, Adrenaline, blood loss, Plastic surgery

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INTRODUCTION

Among other head and neck deformities, the restoration of pharyngeal, oral cavity, parotid, lateral skull base, and cutaneous anomalies has been published lately with the supraclavicular fasciocutaneous flap.[1,2] Patients have been shown to tolerate this flap well, and it has good recipient-site viability and minimal donor-site morbidity.[3] The supraclavicular flap has a clean and steady blood supply, is somewhat thick, and resembles the head and neck region in terms of colour and texture. The procedure just takes a few minutes to do, and the flap is simple to prepare.[4] The supraclavicular flap is becoming more and more common as plastic surgery advances.[5]

Injectable epinephrine has long been utilized to minimize blood loss in plastic surgery cases where bleeding is a common issue. During surgery, bleeding might cause problems such a decrease in haemoglobin, which might require a blood transfusion.[6] Many strategies, including infiltration of vasoconstrictive medications and controlled hypotensive state surgery, have been employed to lessen the amount of bleeding during the procedure. Each of these methods comes with a unique set of challenges and drawbacks.[7]

Vasoconstrictive drugs are increasingly frequently used to stop bleeding during cosmetic and reconstructive surgeries, especially subcutaneous epinephrine.[7,8] Epinephrine has limits due to possible cardiac and local harmful effects. Hydrocarbon anaesthetic delivery exacerbates cardiac toxicities such as tachycardia, arrhythmias, hypertension, and pulmonary oedema.[9] Determining the minimal epinephrine concentration required for appropriate haemostasis during head and neck surgery utilizing a supraclavicular flap would significantly elevate its likelihood of safety because these issues are dose-related.

As far as we are aware, no studies have been conducted on how adrenaline affects bleeding in patients having supraventricular flap surgery. Yet, a study examining the effects of different epinephrine dosages on the degree of vasoconstriction found no appreciable variations in the reduction of blood flow between epinephrine concentrations of 1:100,000, 1:200,000, and 1:400,000. On the other hand, epinephrine at a concentration of 1:800,000 significantly reduced vasoconstriction[10]. The current

study aims to ascertain the impact of varying epinephrine dosages on the amount of blood loss in surgical incisions among patients following supraclavicular flap surgery.

MATERIAL AND METHODS

The present randomized control trial was performed in the Department of Plastic Surgery, Ruth Pfau Civil Hospital, Karachi from September 2022 to September 2023. The trial was first registered on clinicaltrial.gov with trail number NCT05670808 and permission was also sought from the hospital ethical committee (IRB-2533/DUHS/Approval/2022/990). A written informed consent was taken from all patients before enrolling them into the study. Patients of age 18 years and above of either gender, undergoing supraclavicular flap surgery were included. Patients with cardiovascular diseases, collagen vascular diseases and patients on non-steroidal anti-inflammatory drugs, anticoagulants, or aspirin were not included in this study.

Since no similar study has been done before so we performed a pilot study for computing sample size using NCSS PASS version 15. Total blood loss volume for Group 1, Group 2 and Group 3 was 16.3±5.6, 19±9.9 and 56.3±14.7 respectively. At a power of 90% and 5% alpha error, the sample size came out to be less than 30. Thus, for better results, we enrolled 50 participants in each group. Patients were enlisted into the study using non-probability consecutive sampling technique but group allocation was through randomization. A sequentially numbered opaque sealed envelope (SNOOSE) protocol was used for random allocation of patients into three study groups.[11] Group 1 was given 0.9% saline with an epinephrine concentration of 1:200,000. Group 2 was administered 0.9 % saline solution containing a 1:400,000 epinephrine concentration. Group 3 was given just 10 millilitres of 0.9% of saline (control group). Before making the incision, ten millilitres of epinephrine in normal saline were subcutaneously administered under the designated flaps in both intervention groups. The doses were 1:200,000 for Group 1 and 1:400,000 for Group 2. For the control group, just 10 millilitres of regular saline were utilized. A scalpel with 15#blade was used to make a flap incision at the donor area fifteen minutes after the injection. The total blood loss volume was determined using volumetric method (which measures intraoperative blood loss by determining the blood volume in the suction bottle directly) and the gauge pieces method (which weighs the gauze before and after it is saturated with blood and calculates the excess weight in millilitres of blood loss) were used to measure the bleeding for first five minutes (as after completing flap incision, diathermy was used). The post-graduate trainees who were assigned as data collectors recorded the following information on a pre-designed proforma: patient age, gender, operation site, length of surgery (in minutes), and total volume of blood loss.

The collected data was entered in SPSS version 26 to perform statistical analysis. Qualitative data were presented as frequencies and percentages. Quantitative variables were presented as mean±standard deviation. Qualitative variable were compared among three groups using Chi-square test. Numerical variables were compared three groups using one-way ANOVA. Post-hoc Tuckey's test was also applied when one-way ANOVA was significant. Statistical significance was defined as a *p*-value of less than or equal to 0.05.

RESULTS

Overall mean age of 40.9±9.5 years. The majority of participants were males (82%). The most common surgery site was oral cavity (58.7%) followed by neck (21.3%), axila (11.3%) and cheek (8.7%). Table 1 compares features of patients among three study groups.

Table-2 shows a comparison of surgery duration and total blood volume among three study groups. Surgery duration ($p<0.001$) and total blood loss volume ($p<0.001$) both were significantly different among three study groups. Post-hos analysis revealed that surgery duration was significantly different among Group 1 and Group 2 ($p<0.001$), Group 1 and Group 3 ($p<0.001$). On post-hoc analysis for total blood loss volume, significant differences was seen among Group 1 and Group 3 ($p<0.001$), Group 2 and Group 3 ($p<0.001$).

Table-1: Comparison of patients' features among study groups

Variables	Group 1	Group 2	Group 3	*p*-value
Age (in years), mean±SD	42.7±8.5	39.4±9.7	40.7±10.2	0.221
Gender				
Male, n (%)	9(18)	9(18)	9(18)	1.000
Female, n (%)	41(82)	41(82)	41(82)	
Surgery site				
Axila, n (%)	5(10)	3(6)	9(18)	┼0.265
Cheek, n (%)	3(6)	3(6)	7(14)	
Neck, n (%)	9(18)	13(26)	10(20)	
Oral cavity, n (%)	33(66)	31(62)	24(48)	

┼: Fisher-exact test is reported

Table-2: Comparison of surgery duration and total blood loss volume among three study groups

Variables	Groups	N	Mean	SD	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Surgery duration (in minutes)	Group 1	50	168.60	23.38	3.30	161.95	175.24	120.00	180.00
	Group 2	50	204.60	31.89	4.51	195.53	213.66	150.00	240.00
	Group 3	50	205.20	29.29	4.14	196.87	213.52	180.00	270.00
	Total	150	192.80	33.03	2.69	187.46	198.13	120.00	270.00
Total volume of blood loss (in mL)	Group 1	50	15.80	5.37	0.76	14.27	17.32	10.00	30.00
	Group 2	50	19.80	8.44	1.19	17.39	22.20	10.00	60.00
	Group 3	50	57.20	14.14	2.00	53.17	61.22	40.00	100.00
	Total	150	30.93	21.18	1.72	27.51	34.35	10.00	100.00

DISCUSSION

Traditionally, major surgical operations including knee arthroplasty and hemorrhoidal surgery use epinephrine as a local analgesic drug to reduce pain.[12] Peripheral vasoconstriction is the outcome of epinephrine's non-specific alpha- and beta-adrenergic agonist action. As such, it might aid in reducing the absorption of other drugs, boosting the potency, and extending the duration of local infiltration analgesia[13] is also employed, therefore, to reduce perioperative blood loss.[14] As a procoagulant, it has been demonstrated that epinephrine significantly affects fibrinogen release and fibrinogen receptor activation, as well as other coagulation factors whose actions are regulated by beta-adrenergic receptors.[15]

Numerous studies on the role of adrenaline in blood loss have been conducted in the past.[16–18] To ascertain if pterygopalatine fossa injections combined with local anaesthetics and adrenaline are effective in reducing intraoperative bleeding in patients having endoscopic sinus surgery, Kamel AA *et al.*[16] conducted a randomized experiment. The non-injected side experienced a mean blood loss of 173.00±59.10 SD, significantly larger than the injected side's 145.5 ml±69.97 SD. Chethan L. *et al.*[17] conducted a comparison between topical and adrenaline infiltration methods for blood loss at the donor site. They found that the use of adrenaline infiltration resulted in much less blood loss at the donor site (4.7±0.6 ml vs. 10.4±1.2). Benefits of subcapsular adrenaline infiltration were examined by Gupta S. and colleagues about blood loss during open and endoscopic thyroid surgery. Patients in Group 1 underwent normal thyroidectomy without adrenaline, while patients in Group 2 got thyroidectomy with subcapsular infiltration of adrenaline. According to Gupta S's analysis, Group 1's blood loss was considerably less than Group 2's (56.25±5.18 mL against 67.86±4.88 mL).[18]

There are variations in the effects of different amounts of adrenaline. The most widely used preparation is the conventional local anaesthetic ampoule, which has 2% lignocaine and 1:80,000 adrenaline. This means that for every 80,000 parts of solution, there is one part adrenaline.[19] It is important to remember that the ideal safe dosage of local anaesthetics is contingent upon the injection site, pace, and route than it does on the drug load.[20] As previously indicated, the best concentrations of epinephrine depend on the type of surgery and the site; in dermatologic plastic procedures, epinephrine at a concentration of 1:50,000 is used to control bleeding with satisfactory outcomes.[21] It has been shown that the frequency of toxic side effects related to the cardiovascular system increases with dose.[22,23] Our results are consistent with Yang and colleagues' demonstration that varying doses of adrenaline had no discernible impact on bleeding before scalp incision during craniotomy.[24]

In the present study we found that blood loss was lower among Group 1 than other groups but the difference was significant only with Group 1 and Group 3 and Group 2 and Group 3. Rats using surgical incisions to draw blood were used in a similar investigation. Before making the incision, three millilitres of epinephrine in normal saline were subcutaneously administered under the planned flaps at varying concentrations of 1:200,000, 1:400,000, and 1:1,000,000. The 1:200,000, 1:400,000, and 1:1,000,000 groups had average bleeding volumes of 0.2525 mL, 0.2775 mL, and 0.2638 mL, respectively. There was no statistically significant difference between these groups. The control group's average bleeding volume was 0.5038 mL, which was significantly less than that of the other groups. The study concluded that while local epinephrine injections were demonstrated to minimize blood loss from surgical incisions, there was no discernible difference in the amounts of epinephrine[25]. To assess the impact of varying adrenaline concentrations on local bleeding and hemodynamics during dermatologic surgery, Shoroghi *et al.*[21] conducted a study. Three groups were given one percent of injection lidocaine (an average of 5.7 mL) along with three different doses of epinephrine (1:50,000, 1:100,000, and 1:200,000). When comparing the groups administered epinephrine at a concentration of 1:50,000 to 1:200,000, the surgeon's evaluation of bleeding during the surgery was considerably lower in the 1:50,000 group. When given epinephrine

concentrations of 1:100,000 and 1:200,000, there was, however, no apparent distinction between the groups.

CONCLUSION

The present study showed that blood loss was significantly lower among both of the groups of adrenalines but the blood loss from the two doses of epinephrine did not differ significantly.

Conflict of interest

None

AUTHORS' CONTRIBUTION

EN proposed the study concept. FAAK designed the study. AN & SI were involved in data collection, entry and analysis. EN, BZ & RF prepared the initial manuscript draft. FAAK critically revised the initial draft. All authors read and approved the manuscript.

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