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# Intraoperative fluid management of large volume liposuction surgery, cardiometry guided stroke volume variation versus Rohrich formula, a prospective randomized trial

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**Abstract**
**Background:** Fluid management in large volume liposuction is still a big challenge. The objective of the research was to contrast the hemodynamic parameters of fluid resuscitation utilizing the Rohrich formula with those guided by cardiometry stroke volume variations in patients undergoing large volume liposuction surgeries.
**Methods:** Fifty patients undergoing large volume liposuction had been randomized into 2 groups. Rohrich formula group (RF): patients were given IV fluids, managed by Rohrich formula in which intraoperative fluid ratio (IOFR) was 1.2. Electrical cardiometry group (EC): patients received IV fluids according to EC guided stroke volume variation (SVV) and administering intravenous infusion of lactated Ringer's solution (4 ml per kg over 15 minutes) when SVV > 15%. Fluid maintenance (2 ml/kg/h) of lactated ringer was administrated in both groups. Oxygen saturation ($SPO_2$), Mean arterial blood pressure (MAP), heart rate (HR) were continuously monitored and documented besides urine output (UOP), blood volume in aspirate, venous hemoglobin, total aspirate and fluids.
**Results:** MAP was maintained in both groups, $SPO_2$, HR, infiltrated fluids, hemoglobin and blood volume in aspirate were comparable ($p$> 0.05). UOP, IOFR and IV fluids were statistically higher in RF (1.4 ± 0.12 ml/kg/h, 1.2, 2.55 ± 0.52 L) compared to EC (1.2 ± 0.09 ml/kg/h, 1.01 ± 0.03, 1.52 ± 0.55 L) respectively. No consequences had been observed in either group.
**Conclusion:** EC guided SVV is more accurate than RF regarding fluid management in patients undergoing large volume liposuction surgeries.

**Keywords:** Electrical cardiometry, large volume liposuction, stroke volume variation

## Introduction
Liposuction is a widely conducted surgical technique that frequently takes place. There are different techniques of liposuction based on amount of subcutaneous infiltrate and amount of blood loss [1]. These techniques are dry, wet, super-wet and tumescent techniques. Superwet and tumescent are the most common used techniques because they have less blood loss (about 1% of total aspirated volume). The large amount of subcutaneous infiltrate with epinephrine reduce the amount of bleeding during liposuction [2].
Liposuction may be categorized into 2 forms based on the amount of fat removed: large-volume (≥ 4 aspirated litres) and small-volume (less than 4 aspirated litres) [3]. Suction assisted liposuction (SAL) is the standard method for liposuction [4].
Managing fluids in large-volume liposuction presents with difficulties because of fluid shift, loss of blood, and the extensive subcutaneous infiltration. This may lead to hypovolemia or hypervolemia, congestive heart failure and pulmonary edema [5]. Several formulae are used for optimal fluid control during liposuction surgery. Rohrich formula is one of the most common used formulae and based on a ratio between total input and output [6]. Electrical cardiometry (EC) can be used for assessment of fluid status and management in large volume liposuction. It depends on alteration of thoracic electrical bioimpedance and can detect acute changes in cardiac output [7]. Stroke volume variation (SVV) is a reliable indicator for determining whether the patient is fluid responder or not and assessment of volume status of the patient [8].

The aim of our research was to evaluate and contrast the hemodynamic parameters of fluid resuscitation utilizing Rohrich formula with those guided by cardiometry stroke volume variations in patients undergoing large volume liposuction surgeries.

**Patients and Methods**

Following the acquisition of authorization from the Hospital Ethics Committee under protocol number (34637/4/21) and registration on clinicaltrials.gov (ID: NCT05402982), Each participant provided an informed written permission and all information pertaining to patients was kept secure via the use of secret codes and individual private file. This research was conducted on 50 individuals who had large volume liposuction surgeries at Tanta University Hospitals from June 2021 to May 2022.

**Inclusion criteria**

Individuals between the ages of 21 and 60, of either gender, underwent large volume liposuction with American Society of Anesthesiologists (ASA) Physical Status I& II.

**Exclusion criteria**

Individuals with coagulation or bleeding conditions, individuals on frequent antiplatelet or anticoagulant medication, individuals who have had prior surgeries in the treated areas and individuals with substantial cardiopulmonary, liver, or kidney illness were excluded from the study.

During the preoperative anesthetic consultation, history from all patients and general examination were performed followed by routine investigations. Some medications were stopped before surgery as contraceptive pills, herbal medications and smoking for at least 2 weeks. Patients were premedicated using ondansetron 8 mg, paracetamol 1 gm, pantoprazole 40 mg and antibiotic administered intravenously to all patients 1h before operation. Elastic stockings were applied on both lower limbs if the area was not involved in the surgical field for deep venous thrombosis (DVT) prophylaxis.

Basic standard monitoring were applied to the patients including pulse oximetry, capnogram, non-invasive blood pressure (NIBP), electrocardiogram (ECG) and nasopharyngeal temperature probe. Wide bore cannulae were inserted for IV fluids & drugs. After adequate preoxygenation, induction of general anesthesia had been performed using iv 1 µg/kg fentanyl, 2 mg/kg propofol, 0.5mg/kg atracurium. After a cuffed endotracheal tube (ETT) was inserted, Individuals underwent mechanical ventilation utilizing volume-controlled ventilation (VCV) using a tidal volume of (6 ml/kg) and adjustment of parameters to achieve $ETCO_2$ in normal range of 35-45% and 50:50 inspired oxygen in air and sevoflurane 2%. Following induction, foley's catheter was inserted, 10 mg/kg IV tranexamic acid had been given, fentanyl 0.5 µg/kg IV was administered when heart rate or blood pressure increased more than 20% of baseline. Forced air warming device and warming the solutions were used to decrease the incidence of hypothermia.

Participants were assigned to two groups by random allocation using computer-generated numbers concealed in sealed opaque envelope.

**Group A (Rohrich formula)**

Patients were administered lactated Ringer's solution for maintenance (2 ml per kg per hour). The total volume of intravenous (IV) fluids infused was regulated using the Rohrich formula. This formula involved intraoperative fluid ratio (dividing the sum of subcutaneous infiltration fluid and intravenous fluid by the total volume aspirated) of 1.2 [6].

**Group B (Electrical cardiometry)**

The EC (ICON® hemodynamic monitor) was linked to the participant prior to the administration of anesthesia. Prior to electrode placement, the skin was thoroughly cleansed and dried. Four electrodes were used. The first electrode was positioned 5 cm over the level of the neck base, the second electrode was placed directly on the base of the neck, the 3rd electrode was located at the lower left thorax, aligned with the xiphoid process at the level of the anterior axillary line and the 4th electrode was positioned 5 cm beneath the third electrode, also at the level of the anterior axillary line. The EC was linked to the sensor cable, and patient's data were inputted, including age, sex, height, weight, heart rate, blood pressure, hemoglobin, and oxygen saturation.

Patients were administered a fluid maintenance of lactated Ringer's solution at a rate of 2 ml per kg per hour. EC-guided SVV was consistently monitored and documented before and during the administration of anesthesia, also subsequently every 30 minutes until the conclusion of the procedure. A 4 ml/kg dose of lactated Ringer's solution was given as a fluid bolus over a period of 15 minutes when the SVV was more than 15%. In both groups, patients received ephedrine (3 mg) and fluid bolus (4 ml/kg) over 15 min when MAP < 65 mmHg.

**Surgical technique**

The wet solution was warm lactated ringer's solution with epinephrine (1:1,000,000) and 10 ml lidocaine 2%. Traditional SAL was the technique used in liposuction surgery. The super wet approach (involves using an infiltration solution that is almost equivalent to the quantity of fat being aspirated) was implemented with multi-hole blunt tip liposuction cannula. The surgeon administered the wetting solution to the designated location until it felt tense, then proceeded to infiltrate the second site. After a period of 10 to 15 minutes following the infiltration, suction was initiated. The aspirate was gathered in a suction container. Following roughly 1-2 hours, the fat separates from the solution by gravity. The top yellowish portion, which included the fat, is referred as the supernatant. The bottom part, which contained a mixture of blood and fluid, is referred as the infranatant.

The patients were fully reversed from muscle relaxants and extubated at the conclusion of the surgical procedure and thereafter moved to the Post Anesthesia Care Unit (PACU).

**Measurements**

- Demographic information, including age, sex, weight, and BMI, together with the length of the surgical procedure.
- MAP, $SPO_2$, and HR were continually recorded and monitored at certain time intervals during the surgery. These time points were preceding the induction of anesthesia, 5 minutes and 15 minutes following the induction, and then every 30 minutes until the completion of the procedure.
- MAP and HR were measured at a volume of 4 litres of aspiration, and at every subsequent litre until the

completion of the procedure.
- Urine output (UOP) was recorded at every hour till the end of operation.
- Blood loss assessment was performed by: (A) Obtaining a venous blood specimen sample to assess the levels of hemoglobin (Hb) and hematocrit (Hct) when 4 litres were aspirated and for every litre aspirated after. Hb ≤ 8 g/dl was the trigger point for blood transfusion. (B) The blood volume was measured by extracting a sample from the infranatant following separating it from the fat, in order to assess the hemoglobin levels. The blood volume in the aspirate was determined using the following equation [9]:
  Blood volume in aspirate (ml) = [Hb concentration in aspirate (g/dl) × infranatant aspirated volume (ml) / patient's preoperative Hb (g/dl)].
- Total amount of fat, aspirate, intravenous and infiltration fluids.
- SVV in group B before and following induction of anesthesia then every 30 min till the end of surgery.
- Intraoperative fluid ratio was calculated.
- The primary outcome was MAP at 4 aspirated litres and at every aspirated litre after. The secondary outcomes were blood loss assessment and urine output measurement.

**Sample Size Calculation**

The sample size was calculated at N ≥ 22 based on the following criteria:
- 95% confidence limit.
- 80% power of the study.
- Group to group ratio of 1: 1.

We added 3 cases to overcome dropout, therefore we recruited 25 individuals in each group.

**Statistical Analysis**

The data were inputted into the computer and analyzed utilizing the IBM SPSS software program version 20.0, developed by IBM Corp in Armonk, NY. Quantitative data were represented utilizing numerical values and percentages. The normality of the distribution was assessed using the Shapiro-Wilk test and by observing histograms. The quantitative data were presented utilizing the measures of mean and standard deviation. Significance of the obtained results was judged at the 5% level and was adopted at $p< 0.05$.

**Results**

Sixty individuals had been evaluated for eligibility, 6 individuals didn't meet the inclusion criteria (3 individuals were on anticoagulant medications, 3 patients with laboratory results showed coagulopathy) and 4 individuals declined to take part in the trial. The further 50 individuals were assigned to groups at random (25 in each), (Figure 1).

The demographic statistics and length of operation were similar across the groups under investigation, as shown in (Table 1). The two tested groups did not exhibit any notable disparity in vital signs, including MAP, HR, and $SpO_2$, (Fig 2). MAP was maintained during surgery while fluid bolus (4 ml/kg) over 15 min and 3 mg ephedrine were administered when MAP < 65 mmHg.

Urine output (UOP) was substantially higher in Rohrich formula group than EC group. The mean value of UOP (ml/kg/h) in RF group was 1.4±0.12 (1.24 to 1.63 ml/kg/h) while in EC group, the mean value was 1.2±0.09 (0.99 to 1.33 ml/kg/h), (Fig 3). Regarding total fat, aspirate and subcutaneous infiltrate, no substantial variation was existed among both studied groups. The mean values of total aspirate, fat and subcutaneous infiltrate in RF group were 6.5±1.2 L, 5.4±0.9 L and 5.3±0.9 L respectively while in EC group, the mean values were 6.8±1.2 L, 5.5±0.8 L and 5.4±0.8 L respectively, (Table 2).

Venous Hb, Hct, infranatant, Hb and blood volume in aspirate were comparable between the studied groups. The mean blood volume in aspirate in RF group was about (499.6 ± 166 ml) while in EC group, the mean value was about (519.6 ± 165 ml). Hb in aspirate in RF group was about (5.25 ± 0.86 g/dl) while in EC group, it was about (4.96 ± 0.55 g/dl), (Table 2). Two patients received blood transfusion in each group with hemoglobin threshold ≤ 8 g/dl.

Total I.V fluids and intraoperative fluid ratio were substantially greater in RF group contrasted to EC group with $p< 0.05$. Total I.V fluids in RF group had a mean value of (2.55 ± 0.52 L) while in EC group had a mean value of (1.52 ± 0.55 L), (Table 2). Intraoperative fluid in RF group was 1.2 while in EC group, it ranged between 0.94 and 1.06 with a mean value of (1.01 ± 0.03). SVV was recorded in EC group and the number of fluid bolus according to SVV ranged between 1 and 4 boluses, (Table 3).

**Discussion**

Our results showed that RF group was comparable to EC group regarding maintenance of hemodynamic parameters, total infiltrated and aspirated fluids, Hb, Hct as well as blood loss. UOP, intraoperative fluid ratio and IV fluids were statistically greater in RF group contrasted to EC group. Liposuction can lead to disturbance in fluid status so several strategies are used for intraoperative fluid management of liposuction using invasive, non-invasive techniques or empirical formulae based on ratio between total input and output such as Rohrich formula [6]. EC and SVV can be used for fluid responsiveness and assessment of volume status of the patient [8].

Regarding blood pressure, urine output and total I.V fluid in our study: blood pressure was maintained, UOP was 1.4±0.12 ml/kg/h in RF group and 1.2±0.09 ml/kg/h in EC group while total IV fluids were 2.55 ± 0.52 and 1.52 ± 0.55 L in RF and EC groups respectively. In line with our findings, Jain AK *et al*. [10] contrasted fluid management of large volume liposuction between two groups (15 patients in each), group A, SVV guided fluid resuscitation by pulse contour analysis (LIDCO monitor) and group B, with intraoperative fluid ratio (1.2). All operations were done under general anesthesia using superwet technique. They reported no complications, blood pressure was maintained allover operation and average urine output was 1.2 ml/kg/h in group A and 1.5 ml/kg/h in group B. Additionally, they found that SVV can be a guide for fluid management in large volume liposuction especially if patients had associated comorbidities like hypertension or diabetes.

Also, Rohrich *et al*. [6] found that no complications occurred like congestive heart failure pulmonary edema or pulmonary embolism. The study used intraoperative fluid ratio (1.2) for large volume liposuction on 89 patients. SAL with superwet technique was performed for all patients and anesthetized with general anesthesia. MAP was maintained and also urine output was more than 1 ml/kg/h (1.7 ml/kg/h). In line with our results, Trott SA *et al*. [3] used superwet technique and intraoperative fluid ratio (1.4) for large volume liposuction on 53 patients under general anesthesia using

ultrasound assisted liposuction (UAL) technique. Blood pressure was maintained, urine output was >1 ml/kg/h and they reported that no complications occurred. Commons GW *et al*. [11] performed a retrospective analysis of medical records for 631 consecutive individuals who had large volume liposuction using superwet technique and SAL. No intraoperative complications occurred and blood pressure was maintained. Regarding blood loss in our study: blood volume in aspirate was about 499.6 ± 166 ml in RF group and 519.6 ± 165 ml in EC group. Four patients received blood transfusion (2 in each group). Choudry UH *et al*. [12] conducted a retrospective analysis of medical records for all individuals who undergone a large volume liposuction. The procedures were conducted while the patient was under general anesthesia with superwet technique and SAL. They reported that blood pressure was maintained and no major complications occurred. The average total aspirate was 8 L with average IV fluids 4 L. IV fluids given were more than that in our study, this may be because the review included more patients with larger volume of aspirate and combined with other surgeries. There were 5 patients had symptomatic postoperative anemia (weakness, dizziness, tachycardia and hypotension) requiring blood transfusions with a mean hemoglobin level of 7.4 g/dl (ranged between 6.9–8.3 g/dl).

In contrast to our results, Karmo FR *et al*. [9] performed a prospective clinical observational study on 38 patients undergoing SAL with superwet technique under general anesthesia. The mean volume of the liposuction aspirate was about 2.9 L ml with mean blood volume in aspirate about 36 ml. The reported lower blood loss in their study could be explained by their small sample size as well as small volume of aspirate compared to our study. Also, Abo Zeid MF. [13] performed a case-series study on 30 patients who undergoing large volume liposuction under epidural anesthesia plus sedation. The average decrease in the postoperative Hb level was 3.7 g/dl with a maximum value of 7.0 g/dl with no blood transfusion needed. This may be explained by the fact that the recruited patients were with Hb above 12 g/dl or smaller number of patients.

In consistent with our results, Ali Eed MD [14]. Performed large volume and mega liposuction operations on 1520 patients over long period using tumescent technique under general anesthesia. Hemoglobin dropped to reach 7.2 g/dl in some patients with 2% of patients needed blood transfusion. This is may be due to large or mega suction of fat or large sample size. In contrary to our results, Cansancao AL *et al*. [15] compared blood loss between two groups undergoing liposuction utilizing the superwet approach and power assisted liposuction (PAL). The procedures were conducted using local and regional anesthesia. Each group included 10 patients, group 1 received 10 mg/kg tranexamic-acid and group 2 received normal saline (control group). The mean aspirated volume was about 4 L with mean blood volume in aspirate about (37-59 ml). Blood loss was less when compared to our study, this may be due to higher concentration of epinephrine (1:500,000), small volume of aspirate, using PAL or doing operation under regional anesthesia. Our findings didn't agree with Garcia Jr O *et al*. [16] and Samdal F *et al*. [17], may be because of smaller volume of aspirate or small sample size compared to us.

EC was helpful in fluid management and assessment of fluid status of the patient. Angappan S *et al*. [18] carried out a study to analyze the effectiveness of SVV for predicting response to fluid and contrast it to conventional methods of evaluating volume status such as central venous pressure. SVV measured by the Vigileo-FloTrac system of pulse contour analysis. The study concluded that when predicting fluid responsiveness, SVV is more effective and its trends could also be utilized to track changes in cardiac index and cardiac output.

In line with our study, Sanders M *et al*. [8], Rady Abdalla S *et al*. [19], De Waal EEC *et al*. [20] showed that EC is effective and can be used as a trend monitor to measure acute changes in cardiac output.

Regarding complications, no complications like pulmonary edema, pulmonary embolism, DVT occurred in our study. Sciard D *et al*. [21] and Rao RB *et al*. [22] reported complications related to liposuction surgery such as lidocaine toxicity, pulmonary thromboembolism and pulmonary edema.

**Table 1:** Demographic data and duration of surgery in the two studied groups.

| | **Rohrich formula** | **EC** | **P** |
|---|---|---|---|
| Age (year) | 34.84 ± 9.62 | 35.84 ± 10.05 | 0.721 |
| **Gender** | | | |
| Male | 10 (40.0%) | 9 (36.0%) | 0.771 |
| Female | 15 (60.0%) | 16 (64.0%) | |
| Weight (kg) | 101.9 ± 11.65 | 102.8 ± 10.13 | 0.777 |
| BMI (kg/m$^2$) | 35.32 ± 3.36 | 35.72 ± 3.12 | 0.665 |
| Duration of surgery (h) | 3.04 ± 0.60 | 3.05 ± 0.73 | 0.986 |

Data presented as mean ± SD and patient number (%).
BMI (body mass index), Electrical cardiometry (EC).
$p < 0.05$ indicates statistical significance.

**Table 2:** Aspirate, total fluids and blood loss assessment parameters in the two studied groups.

| | **Rohrich Formula** | **EC** | **P** |
|---|---|---|---|
| | 6.53±1.17 | 6.79±1.18 | 0.437 |
| Total fat (L) | 5.35±0.87 | 5.45±0.83 | 0.680 |
| Total infiltrate (L) | 5.28±0.91 | 5.38±0.81 | 0.707 |
| I.V fluids (L) | 2.55±0.52 | 1.52±0.55 | <0.001* |
| Infranatant (L) | 1.18±0.33 | 1.34±0.37 | 0.113 |
| Preoperative Hb (g/dl) | 12.42±0.99 | 12.83±0.94 | 0.134 |
| Hb in aspirate (g/dl) | 5.25±0.86 | 4.96±0.55 | 0.166 |
| Blood volume in aspirate (ml) | 499.60±166 | 519.60±165.2 | 0.671 |

Data presented as mean ± SD.
Hemoglobin (Hb), Intravenous (IV).
$p < 0.05$ indicates statistical significance.

**Table 3:** SVV % in group B (Electrical cardiometry).

| **Cases No.** | **SVV %** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Before induction** | **After induction** | **30min** | **1h** | **1.5h** | **2h** | **2.5h** | **3h** | **3.5h** | **4h** | **End of surgery** |
| Mean | 12.24 | 13.64 | 14.24 | 14.92 | 15.64 | 14.63 | 15.95 | 15.77 | 16.71 | 15.00 | 12.76 |
| ±SD. | 1.33 | 1.60 | 1.59 | 2.71 | 2.77 | 1.79 | 2.74 | 2.77 | 3.55 | 1.58 | 0.83 |

Data presented as mean ± SD.
Stroke volume variation (SVV).
$p < 0.05$ indicates statistical significance

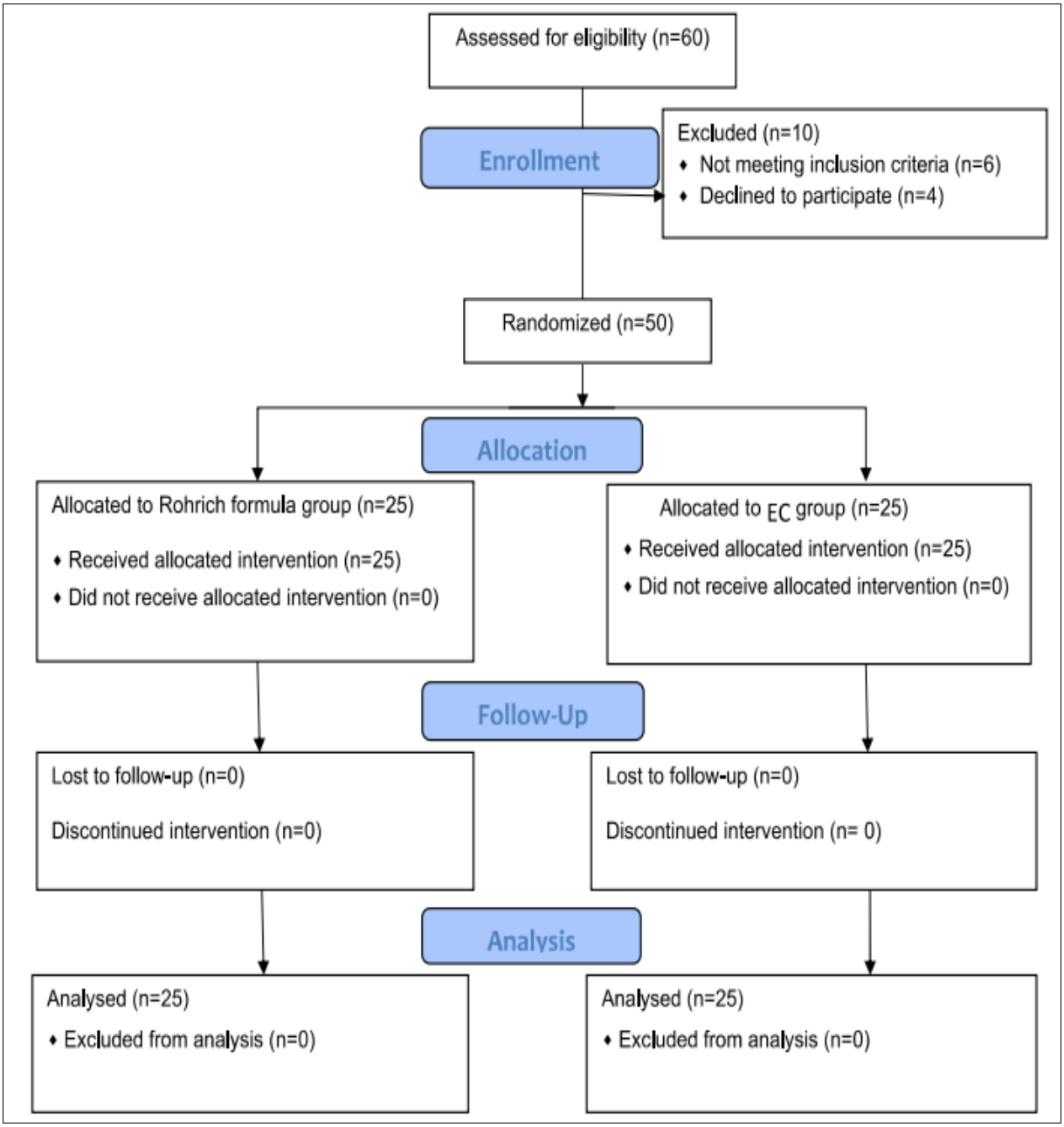
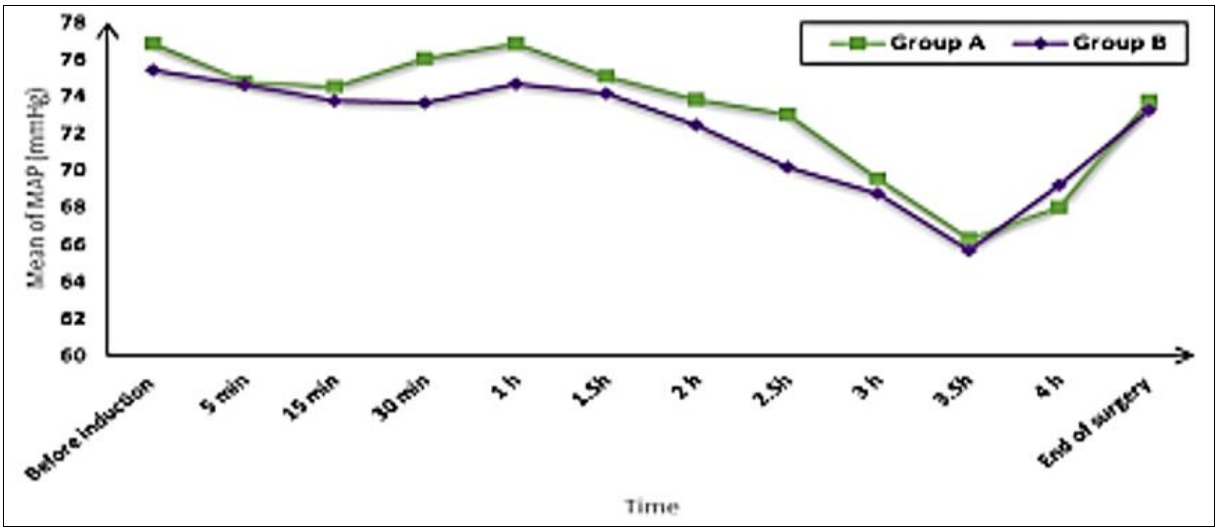



**Fig 1:** Consort flow chart of participants



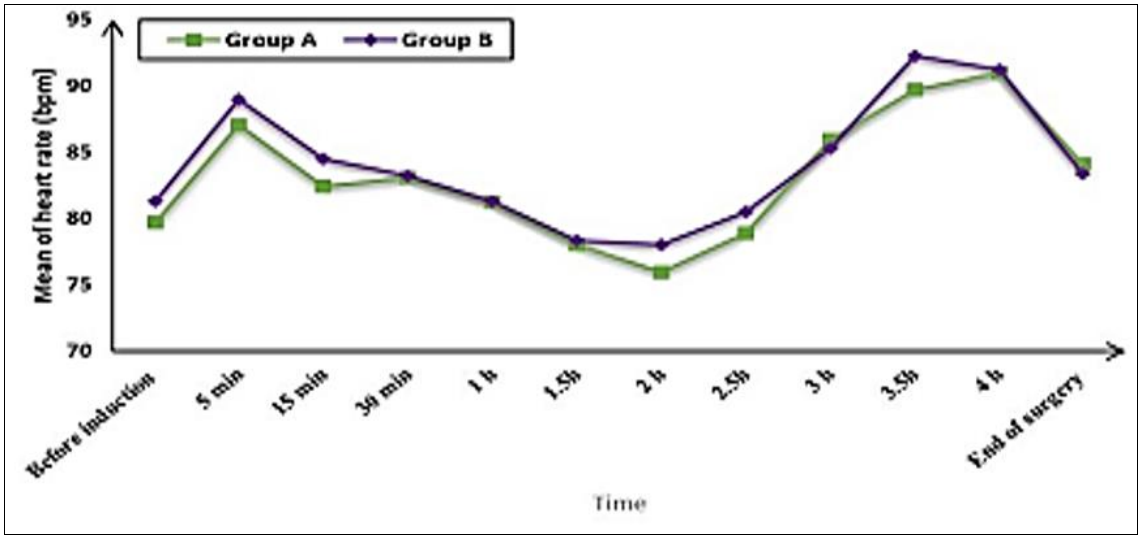



**Fig 2:** Heart rate (bpm) and MAP (mmHg) in the two studied groups

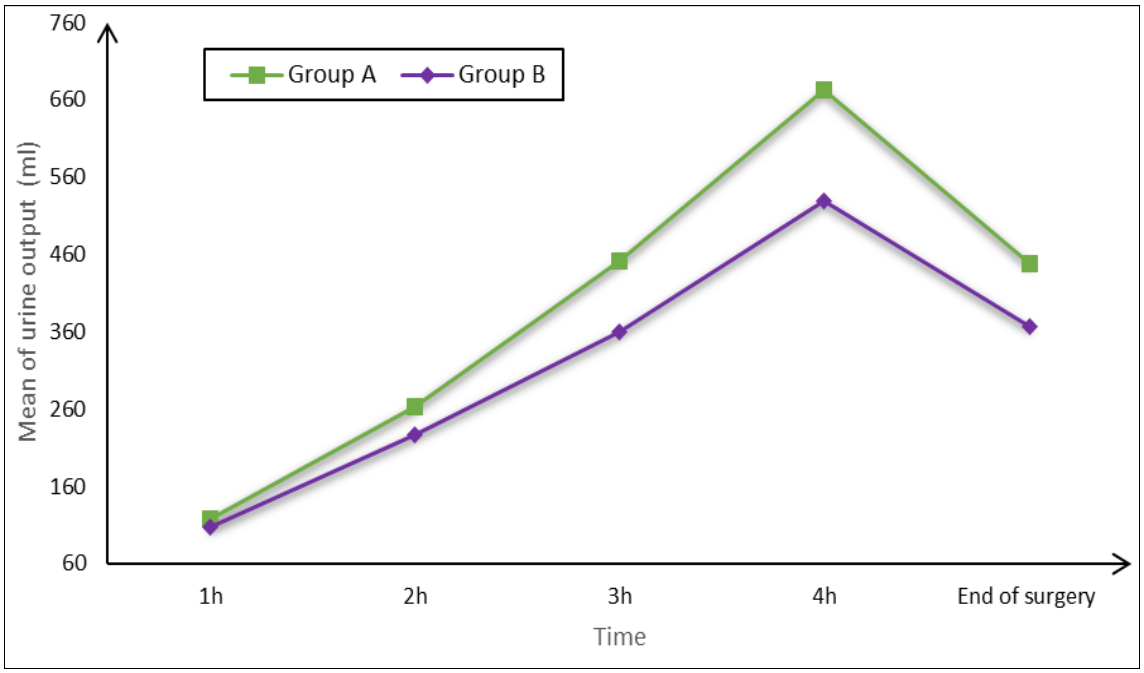



**Fig 3:** Total urine output (ml) in the two studied groups

## Conclusion

Electrical cardiometry guided stroke volume variation is more accurate than Rohrich formula in fluid resuscitation and management in patients undergoing large volume liposuction surgery.

## Limitations

In addition to the relatively small sample size, our study was single blinded as it wasn't feasible to blind the anesthesiologist performing the intraoperative fluid management. In addition, we didn't follow up the postoperative clinical status and laboratory investigations. Lastly, we didn't investigate the electrolyte and metabolic disturbance in our cases.

## Recommendations

We recommend using intraoperative fluid ratio < 1.2 for empirical fluid management in liposuction patients because intraoperative fluid ratio of 1.2 was associated with more urine output that means over resuscitation compared to EC group. Additional trials are required with larger sample size for detection of accuracy of cardiometry guided SVV among individuals undergoing large volume liposuction surgery especially in patients associated with comorbidities. We recommend studies to investigate other hemodynamic parameters of EC like corrected flow time, thoracic fluid content, cardiac output with or without SVV. Future studies should be done with involving other intraoperative fluid ratios. Other non-invasive or invasive devices for intraoperative fluid management among individuals undergoing LVL surgery should be investigated.

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**Conflict of Interest:** Nil.

## References

1. Pacifico M, Kanapathy M, Dancey A, *et al*. Summary document on safety and recommendations for aesthetic liposuction: Joint British Association of Aesthetic

Plastic Surgeons (BAAPS)/British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS) expert liposuction group. J Plast Reconstr Aesthet Surg. 2022;75(3):941-7.
2. Stephan PJ, Kenkel JM. Updates and advances in liposuction. Aesthet Surg J. 2010;30(1):83-97.
3. Trott SA, Beran SJ, Rohrich RJ, *et al*. Safety considerations and fluid resuscitation in liposuction: an analysis of 53 consecutive patients. Plast Reconstr Surg. 1998;102(6):2220-9.
4. Regatieri FL, Mosquera MS. Liposuction anesthesia techniques. Clin Plast Surg. 2006;33(1):27-37.
5. Tabbal GN, Ahmad J, Lista F, *et al*. Advances in liposuction: five key principles with emphasis on patient safety and outcomes. Plast Reconstr Surg Glob Open. 2013;1(8):e75.
6. Rohrich RJ, Leedy JE, Swamy R, *et al*. Fluid resuscitation in liposuction: a retrospective review of 89 consecutive patients. Plast Reconstr Surg. 2006;117(2):431-5.
7. Stetzuhn M, Tigges T, Pielmus AG, *et al*. Detection of a Stroke Volume Decrease by Machine-Learning Algorithms Based on Thoracic Bioimpedance in Experimental Hypovolaemia. Sensors (Basel). 2022;22(14).
8. Sanders M, Servaas S, Slagt C. Accuracy and precision of non-invasive cardiac output monitoring by electrical cardiometry: a systematic review and meta-analysis. J Clin Monit Comput. 2020;34(3):433-60.
9. Karmo FR, Milan MF, Silbergleit A. Blood loss in major liposuction procedures: a comparison study using suction-assisted versus ultrasonically assisted lipoplasty. Plast Reconstr Surg. 2001;108(1):241-7.
10. Jain AK, Khan AM. Stroke volume variation as a guide for fluid resuscitation in patients undergoing large-volume liposuction. Plast Reconstr Surg. 2012;130(3):462e-9e.
11. Commons GW, Halperin B, Chang CC. Large-volume liposuction: a review of 631 consecutive cases over 12 years. Plast Reconstr Surg. 2001;108(6):1753-63.
12. Choudry UH, Hyza P, Lane J, *et al*. The importance of preoperative hemoglobin evaluation in large volume liposuction: lessons learned from our 15-year experience. Ann plast surg. 2008;61(3):230-4.
13. Abo Zeid MF. Perioperative Monitoring and Control of Large Volume Liposuction: A Case Series Study. The Egyptian J Plast Reconstr Surg. 2019;43(1):41-5.
14. Ali Eed MD. Mega-Liposuction: Analysis of 1520 Patients. Aesthet Plast Surg. 1999;23(1):16-22.
15. Cansancao AL, Condé-Green A, David JA, *et al*. Use of tranexamic acid to reduce blood loss in liposuction. Plast Reconstr Surg. 2018;141(5):1132-5.
16. Garcia Jr O, Nathan N. Comparative analysis of blood loss in suction-assisted lipoplasty and third-generation internal ultrasound-assisted lipoplasty. Aesthet Surg J. 2008;28(4):430-5.
17. Samdal F, Amland PF, Bugge JF. Blood loss during suction-assisted lipectomy with large volumes of dilute adrenaline. Scand J Plast Reconstr Surg Hand surg. 1995;29(2):161-5.
18. Angappan S, Parida S, Vasudevan A, *et al*. The comparison of stroke volume variation with central venous pressure in predicting fluid responsiveness in septic patients with acute circulatory failure. Indian J Crit Care Med. 2015;19(7):394.
19. Rady Abdalla S, Abdelazeem AS, Kaddah TA, *et al*. Hemodynamic monitoring and correlation between electrical cardiometry and esophageal Doppler in patients undergoing major abdominal surgery. Egyptian J of Anesth. 2023;39(1):418-25.
20. De Waal EEC, Rex S, Kruitwagen CLJJ, *et al*. Dynamic preload indicators fail to predict fluid responsiveness in open-chest conditions*. Crit Care Med. 2009;37(2):510-5.
21. Sciard D, Leiman DG. Perioperative Management of Super Wet Liposuction: A Case Report. AMBULATORY. 2010:20.
22. Rao RB, Ely SF, Hoffman RS. Deaths related to liposuction. N Engl J Med. 1999;340(19):1471-5.

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