Effect of Irrigation of Triamcinolone Versus Hypertonic Saline in Decreasing Seroma Post Abdominoplasty

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Background: Lipo-abdominoplasty is a cornerstone of body contouring surgery, yet its success is often hindered by the persistent problem of seroma formation. Despite numerous technical refinements, no single method has completely eliminated this complication. Recently, pharmacologic irrigation has gained attention as a novel adjunct, with triamcinolone and hypertonic saline emerging as promising agents. By modulating inflammation and reducing fluid accumulation, they hold potential to minimize one of the most frequent challenges in abdominoplasty

Methods: A comparative study was conducted on 90 patients who underwent abdominoplasty at Kasr AL Ainy hospital between November 2023 until July 2025. Patients were randomized into three groups of 30 each: Group A received intraoperative irrigation with triamcinolone over the abdominal wall, Group received intraoperative irrigation with hypertonic saline over the abdominal wall and Group C served as the control group.

Results: our primary goal was the incidence of postoperative seroma, which was 16.7% in Group B and 23.3% in Group A compared to the control group which had an incidence of 33.3 %. On the other hand, Group A had a mean of 7.43 ± 1.48 days regarding drain removal compared to Group B which had a mean of 8.23 ± 1.74 days and Group C which had a mean of 11.5 ± 1.2 days.

Conclusion: Both triamcinolone and hypertonic saline irrigation over abdominal wall during lipo-abdominoplasty facilitated earlier drain removal and reduced total output. Also, both showed favorable, yet non-significant reductions in seroma incidence post-abdominoplasty.

Introduction:

Lipo-abdominoplasty, since first introduced by Saldanha, had become the gold standard technique for abdominal contouring. Lipo-abdominoplasty is a transformative procedure whose impact on patients' quality of life is profound. Thus, it is one of the most commonly performed aesthetic procedures. **(Saldanha, 2001)**

As the saying goes, "**Every rose has its thorn**", achieving better aesthetic results usually comes with more complications. Therefore, if only one complication needs to be mentioned to all patients post abdominoplasty, it is seroma. Seroma is the most common local complication with incidence with a range of 5 to 57% to an extent that some authors called it the "necessary evil" because seroma is not only a complication, it sets off a domino effect of complications including infection, skin fap necrosis, patient dissatisfaction and pseudo-bursa. **(Salari et al., 2021)**

The two major theories behind the occurrence of seroma mentioned in literature was the role of dead space with disruption of lymphatics and the inflammatory response with cytokine involvement. **(Liao et al., 2024).**

All the causes described in literature and all the proposed preventive measures aim to address either one or both theories. An ideal method is a method that achieve the targeted goal with no drawbacks. The presence of multiple preventive modalities in literature is a proof that none of these modalities is optimum and that the seroma issue post-abdominoplasty is still a challenge that surgeons are trying to overcome and continues to be a problem that needs further solutions.

On the other hand, irrespective of the conflict of whether drains prevent or enhance seroma, drains are still implemented by 98% of plastic surgeons. Drains per se are associated with postoperative pain and retrograde infection. Drains are nuisance for patients. **(Seretis et al, 2017)**

Intraoperative pharmacological irrigation had gained popularity as a promising adjunct. Triamcinolone is an anti-inflammatory agent. It is logical that triamcinolone will be effective in quenching the inflammatory response post operative resulted from the trauma of dissection and liposuction which will definitely increase the incidence of seroma, the drain output and delay the removal of the drains. Therefore, by inference, triamcinolone tackles one of the major theories behind seroma which is the fact that it is an inflammatory response with cytokine involvement. Hypertonic saline is a potent sclerosing agent so it comes as no surprise that hypertonic saline will address the other major theory behind seroma formation which is the role of dead space and lymphatic disruption by sealing the dead space thus decrease the incidence and volume of seroma and obviously affects the output and removal of the drains. Both are an easy, simple, cheap and fast methods without affecting the operative time or the aesthetic outcome. Furthermore, both drugs are widely used in medicine which is a validation of safety. **(Bhosale et al , 2024)(Zhang et al, 2023)**

Methods:

A total of 90 abdominoplasty patients were recruited in this study from November 2023 until July 2025. These patients presented to the outpatient clinic of the Plastic and Reconstructive Surgery Department, Kasr Al ainy Hospital with pendulous abdomen or manifestations of myofascial abdominal laxity and weakness or more commonly, a combination of both. In additions, almost all patients were complaining of localized stubborn fat deposits usually in the flank and epigastric areas that also needed to be addressed. These patients were randomly assigned into three groups: **Group A:** Triamcinolone group, **Group B**: Hypertonic saline group, **Group C:** Control group

Randomization:

It was performed using the closed envelope technique. Opaque, sealed and sequentially numbered envelopes containing group assignments were prepared by an independent participant not enrolled in the study. Each envelope was opened only after a participant enrollment, ensuring allocation concealment and preventing selection bias.

Inclusion criteria:

1) Females
2) Age: 18-65
3) BMI ≤ 39
4) Pendulous abdomen grades 3 and 4 according to the Matarasso classification of 1991.

Exclusion criteria:

1. Age: < 18 years and > 65 years
2. BMI: >39.1
3. Known allergies to steroidal compounds
4. Uncontrolled medical comorbidities
5. open abdominal surgeries other than caesarian sections.
6. Ventral hernias
7. Ehlers-Danlos and other hyper elasticity syndromes

Protocol:

Pre-operative: Before admission, patients were consented on the study methodology and the randomization process. The initial consultation of our patients revolved around the expected procedural details, the preoperative preparatory steps and the post-operative recovery time and details. Afterwards, proper history and examination were conducted along with routine preoperative labs and abdominal ultrasound to detect hernial defects.

Preoperative markings: In the standing position, after proper exposure of the trunk area, Markings of the liposuction area over the back were done. Followed by anterior markings which begins with identifying the anterior midline and marking both linae semilunaris while the patient contracts the rectus abdominis muscles. Next, the lateral ends of the expected abdominal scars are marked at the abdominal fold with the patient flexing the trunk 30 degrees. The midpoint of the proposed incision site is then marked in the midline at 6-8 cm under medium stretch, confirmed at 8-10 cm under maximum stretch. Measurements of 7 cm lateral to the midline at this site and 9 cm from the midline above the umbilicus are taken, ensuring these points coincide during closure for 2 cm abdominal flap medialization. This midpoint connects laterally to the 7 cm marking and then to the proposed incision ends. Using a pinch test, the proposed upper incision is marked in the midline above the umbilicus and connected to the lateral ends of the proposed lower incision. Finally, areas for liposuction in the anterior flanks and epigastrium are marked.

Operative details: The patient is placed prone, sterilized, draped, and positioned in jack-knife for initial preparation, receiving one dose of a 3rd generation cephalosporin. Super wet solution (1 mg adrenaline, 1 mg tranexamic acid, and 10 cc of 2% lidocaine per 500 ml normal saline) is infiltrated via sacral and bra-line access incisions, followed by a 15-minute wait, then liposuction in marked areas using a straight Mercedes-shaped blunt-tipped 4 mm cannula until a desirable pinch is achieved. The patient is turned supine with trunk extension at the hips, re-sterilized, draped, and anterior access incisions made for infiltrating the same super wet solution into flanks and epigastrium, awaiting 15 minutes before liposuction to desirable pinch endpoint. The proposed incision site opens slantingly to preserve fat over anterior superior iliac spines, followed by uniform supra-fascial dissection to the umbilicus; the umbilicus is incised superficially, dissected to the anterior rectus sheath, circled to free its stalk, and a narrow epigastric tunnel elevated supra-fascial along medial rectus borders per Saldanha's technique without wider undermining. Plication of divarication occurs in two layers above and below the umbilicus with PDS 1-0 loop and proline 1-0 if indicated. The patient flexes to 45 degrees for flap excision, with two suction drains placed laterally; the neo-umbilicus is incised appropriately, umbilicus brought up, and closure performed in layers using 0 Vicryl for Scarpa's fascia, 2-0 Vicryl sub-dermally, and 3-0 Monocryl sub-cuticular. Drains are closed, then per group: Group A (triamcinolone) irrigates 10 cm saline mixed with two 40 mg vials through the umbilicus into dead space; Group B (hypertonic saline) irrigates 20 cm of 10% solution similarly; Group C (control) receives no irrigation. Doses were used according to best available evidence. The umbilicus secures with 4-0 Vicryl interrupted dermal and 4-0 Monocryl subcuticular skin sutures. A compression garment with underlying foam support are applied immediately.

Post-operative sequalae: The patient is transported to the ward in a semi-sitting position and maintained this way until discharge. Drains remain closed for 1 hour postoperatively, then fluid amount and color (categorized as dark red, serosanguineous, or serous) are measured and documented every 12 hours until removal, with patients instructed pre-discharge on consistent drainage collection and measurement, documenting every 12 hours themselves. Early ambulation with regular fluid intake prevents VTE, and chemoprophylaxis starts if indicated per the 2005 Caprini score. The first dressing occurs the next day to detect early liposuction complications, followed by discharge on antibiotics and analgesics. Lymphatic massage begins as early as postoperative day 3. Follow-up visits schedule weekly for the first 6 weeks, every 2 weeks for the next 6 weeks, then monthly for 3 months, during which drains are inspected and removed when output is less than 50 cc in 24 hours.

In cases of seroma: Clinical seromas, diagnosed by palpable bulge or swelling, are addressed and aspirated using a wide bore cannula and 20 cc syringe. The amount of aspirated fluid is documented per session. And the sessions are repeated every 3 to 4 days according to the patient's condition till the seroma is resolved.

Statistical methods: Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean, standard deviation, median, minimum and maximum for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Group compariason were done using unpaired t test or analysis of variance (ANOVA) with multiple comparisons post hoc test in normally distributed quantitative variables while non-parametric Kruskal-Wallis's test and Mann-Whitney test were used for non-normally distributed quantitative variables **(Chan, 2003a)**. For comparing categorical data, Chi square ($\chi 2$) test was performed. Exact test was used instead when the expected frequency is less than 5 **(Chan, 2003b)**. Correlations between quantitative variables were done using Spearman correlation coefficient **(Chan, 2003c)**. P-values less than 0.05 were considered as statistically significant**.**

Study outcomes:

This randomized controlled study was designed to evaluate the results of intraoperative irrigation of different material on the incidence of seromas (primary outcome)along with earlier drain removal and drain output (secondary outcome).

Results:

The patients' age ranged between 20 and 59 years and their BMI ranged between 23 and 39. All patients demographics were statistically insignificant along with the infiltration and liposuction volume which ranged between 0.5 and 6 litres. The relation between our outcomes were also statistically insignificant including the seroma incidence and volume with the day of drain removal. The relation between the lipoaspirate volume and the clinical seroma incidence in each group were statistically insignificant except in group A with P value equals 0.001 but they all showed a directly proportional relation in which the incidence of clinical seroma is higher with larger volumes of liposuction. On the other hand, the lipoaspirate volume was statistically related to the drain output with P value less than 0.001.

Although the incidence and volume of seroma was statistically insignificant yet it was numerically different showing the effect of triamcinolone and hypertonic saline in decreasing the seroma incidence and total volume with the hypertonic saline group to be the most effective with incidence of 16.7% compared to 23.3% in the hypertonic saline group and 33.3% in the control group.

The day of drain removal in the patients ranged between 5 & 14 days (SD ± 1.48, 1.74,1.2) for groups A, B and C respectively with significant difference between the effect of triamcinolone and hypertonic saline in early drain removal. The Post hoc pair wise comparisons between each group and the other in early removal of the drain showed no significant difference between the effect of triamcinolone and hypertonic saline groups but both show significant difference with P value less than 0.001 compared to the control group.

The mean drain output in the patients ranged between 38.75 & 289.29 (SD ± 57.48,61.63,30.69) for groups A, B and C respectively and the total drain output showed statistical significance of P value less than 0.001. Post hoc pair wise comparisons between each group and the other regarding the mean drain output and total drain output showed significant difference between hypertonic saline and triamcinolone groups in the mean drain output. On the other hand, there was significant difference between the triamcinolone group and the control group in the total drain output.

The Drain composition(color) was categorized into the "Minimum day color" ,which is the color or the composition of the drained fluid on the earliest day of drain removal in each group separately, and the "Maximum day color", which is the color or the composition of the drained fluid on the latest day of drain removal in each group separately, along with the "Mean day color" which is the mean between both. The "Minimum day color" showed statistical significance of P value less than 0.001.

Discussion:

This is the first study ever to assess the effect of both triamcinolone and hypertonic saline on decreasing the incidence of seroma and on the drains. The association between either triamcinolone and hypertonic saline with seroma post abdominoplasty is sparce in literature making it difficult to compare our results. Yet, they are considered novel innovative methods affecting the seroma and the drains. Our idea arose from authors who used either hypertonic saline in seroma prevention post other surgeries and triamcinolone in seroma prevention in abdominoplasty.

Regarding this study population, the mean BMI in this study wa**s** 29.03 to 30.57 kg/m^2. These results in comparison to **Liao and his colleagues'** results**,** their mean BMI was 23.7 to 27.9 kg/m^2 and **Seretis and his colleagues'** results**,** their mean BMI was ranged from 23.7 to 27.7 kg/m2. The inclusion criteria of this study were BMI < 35 kg/m2 to exclude the higher risk of complications associated with BMI more than 35 kg /m2 and the lower complications with lower BMI. **(Liao et al., 2024 and Seretis et al., 2017)**. When comparing the incidence of seroma, the drain removal and output of this study to the patients' BMI, there were almost no statistical relevance found.

Liposuction, as a sole procedure, affects the incidence and volume of seroma and affects the drain output as well. This effect occurs through disrupting lymphatic drainage, increasing tissue trauma and creation of dead space. All these factors collectively promote the accumulation of serous fluid which is both managed through the drains and may lead to seroma formation. Therefore, most authors added liposuction to their exclusion criteria when their aim involve seroma such as **Anker and his colleagues** did in order to eliminate the variable of liposuction and make their results more specific. This point is very critical when comparing the results of our study with them. **(Anker et al., 2021).** Since lipo-abdominoplasty is increasingly recognized as the standard abdominoplasty because it achieves better aesthetic result in abdominal contouring, we were not able to exclude it in our study. The main idea behind the inclusion of liposuction in our study is that we did not want to change the path, we just wanted to overcome the obstacle in it. We advocate for this technique since it achieves the best outcome in our patients and our aim was trying to eliminate the pitfalls of it. By reviewing our results, in spite of observing a directly proportional relation between the volume of lipoaspirate and the incidence of seroma which is increased with more volumes, they showed statistical insignificance. Meanwhile, the mean drain output and the total drain output were majorly affected by the volume of lipoaspirate. Both the total drain output and the mean drain output were statistically relevant to the volume of lipoaspirate with P value of < 0.001.

Studies that revolve around seroma in abdominoplasty usually have interplaying factors that affect the seroma incidence, the volume of seroma, the drain output or the day of drain removal. **Anker and his colleagues** not only excluded liposuction in their study but also preserve the scarpa's fascia while using triamcinolone. **Bromley and his colleagues** combined drains, progressive tension sutures and compression garments with exclusion of liposuction and patients with BMI more than 30 kg/m2. **(Bromley et al., 2018 and Anker et al., 2021)**. In the study on hand, we tried to unify most of the factors

affecting seroma. We used compression garments postoperative for six weeks. Pressure garments play a crucial role in enhancing surgical outcomes and improve contouring by providing uniform compression. They help in minimizing the dead space and is considered one of the prevented measures of seroma mentioned in literature.

Through the review of literature, triamcinolone was proven to be effective in decreasing the incidence and volume of seroma in various types of operations. None of those studies mentioned its effect on neither the drain output nor the drain removal after lipo-abdominoplasty. **(Qvamme et al., 2015 and Hart et al., 2017).** Only **Anker and his colleagues** pursue the effect of triamcinolone irrigation on the inflammatory response in seroma exudate in abdominoplasty which used a single 80-mg dose of triamcinolone diluted in 10 ml of saline solution immediately before definite wound closure. We used the same dose. **(Anker et al., 2021).** Counterintuitively, the use of triamcinolone wasn't held accountable for any wound healing complications or any local or systemic side effects due to the use of a single dose. **(Anker et al., 2024).**

Not even a single author or study has ever mentioned the use of hypertonic saline in seroma prevention after lipo- abdominoplasty. Yet, this does not imply the lack of use of hypertonic saline in seroma in general. Although, literature was very skimpy in that area, **Dudai & Gilboa** managed to prove the effect of hypertonic saline on seroma formation and early removal of the drain in extended endoscopic hernia. **(Dudai & Gilboa, 2019).** Following in the footsteps of **Wang & Xie**, who proved the role of hypertonic saline irrigation in preventing seroma in cases of axillary bromhidrosis and used 10ml of 10% hypertonic saline, the same dose was used in this study. **(Wang & Xie, 2024)**

This study is the first to use two drugs with different mechanisms targeting seroma's main foundations post-lipo-abdominoplasty and to assess hypertonic saline irrigation's effect on seroma along with the triamcinolone irrigation's effect on drain removal/output. Also, the comparison of triamcinolone vs. hypertonic saline on seroma/drains.

A control group served as benchmark due to limited prior studies. Bromley et al. (2018) reported 9-12% seroma incidence. Our results were triamcinolone group had 23%, hypertonic saline 16%, control 33%. Anker et al. (2021) found that triamcinolone reduced the seroma volume to 236±381 ml but excluded liposuction and preserved Scarpa's fascia. Our triamcinolone mean was 614±397 ml, hypertonic saline 328±287 ml, control 428±300 ml. Hypertonic saline numerically lowered seroma incidence/volume. So, the primary outcome showed that Both groups better than control numerically, but insignificant. On the other hand, the secondary outcome showed unpreceded finding with statistical significance of both groups which enabled earlier removal vs. control with $P < 0.001$. triamcinolone needed 7.43±1.48 days, hypertonic saline needed 8.23±1.74 days while control needed 11.5±1.2 days. Early removal did not affect seroma incidence or seroma volume. Regarding the drain output, both reduced it significantly, favoring triamcinolone (least mean output, less sanguineous/more serous composition.)

LIMITATIONS

1. The study did not standardize the amount of lipoaspirate removed during the procedures, which may have introduced variability in outcomes.

2. The relatively limited sample size may restrict the generalizability of the results.

CONCLUSION

Irrigation of the abdominal wall with triamcinolone and hypertonic saline during lipo-abdominoplasty has shown meaningful clinical benefits. Both agents facilitated earlier drain removal and reduced overall drain output, outcomes that directly enhance patient recovery and comfort.

While the reduction in seroma incidence was not statistically significant, the favorable trend highlights their potential as practical adjuncts in minimizing one of the most persistent challenges of abdominoplasty.

RECOMMENDATIONS

1. Future research should include multicentric studies involving different surgeons to enhance the external validity of the findings.

2. Efforts should be made to unify additional variables, particularly the amount of lipoaspirate aspirated, to reduce confounding factors and allow for more accurate comparisons

Consent Form for Participation in Research

* Study purpose:

Comparing the effect of irrigating triamcinolone (a corticosteroid) versus high-concentration saline solution on reducing seroma (fluid buildup) after abdominoplasty (tummy tuck) surgery.

* What's required from the participant:

Agreement to undergo the medical examination, the surgery with the study protocol intervention, and follow-up visits.

* Time commitment:

6 months after the surgery.

*Risks:

- Hematoma (blood collection/bruising under the skin)
- Allergic reaction to the corticosteroid
- Wound infection
- Seroma (fluid buildup)

*Benefits to the participant and community:

Reduced seroma formation after abdominoplasty.

*Alternatives if the patient doesn't wish to participate:

Continued standard care without enrolling in the study.

(Signing this consent form does not waive any of your legal rights, nor does it release the researchers, sponsor, or institution from their professional or legal responsibilities.)

For Complaints: Contact the Research Ethics Review Committee office at phone number 01003657120.

If you agree to participate, please indicate in the appropriate space below:

- All information in this agreement has been explained to me: ___
- I have read and understood the information in this agreement: ___
- Participant's name: _____ • Signature: _____
- Witness to the consent process: _____
- Witness's signature: _____
- Study investigator's signature: _____
- Date: _____

Valid from: ___ to ___