

Original Research Article

Intra abdominal pressure changes in meshplasty and abdominal wall plication techniques in abdominoplasty: a comparative study

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ABSTRACT

Background: Measurement of intra abdominal pressures is used to identify patients at risk of intra-abdominal hypertension and abdominal compartment syndrome after abdominoplasty that may lead to tight closure of the abdomen. This comparative study was aimed at measuring the IAP of patients in groups of meshplasty and abdominal wall plication, intraoperatively and post operatively.

Methods: A comparative study was conducted among 34 patients who underwent meshplasty and abdominal wall plication. Each group comprised of 17 patients. All preoperative blood investigations and pre anesthetic evaluations were done. The technique used is decided based on the soft tissue laxity, rectus diastasis and presence of ventral hernias. Intra operatively, IAP was measured soon after the placement of mesh or after Rectus plication and post operatively, IAP was measured within 24 hours. IAP was measured using the intra vesical technique using Foley's Catheter.

Results: Fifty percent of the total patients were in the age group 41-50yrs and 88.2% of the patients were females. No significant variations in IAP, either intraoperative ($p=0.051$) or post operative ($p=0.202$), was evidenced in both groups. Post operatively, patient developed minimal complications such as seroma collection, wound infection and respiratory complications, improving on symptomatic treatment and antibiotics.

Conclusions: No significant intraoperative or postoperative IAP was found between the two study groups underwent meshplasty and abdominal wall plication techniques.

Keywords: Abdominoplasty, Mesh plasty, Rectus plication, Intra-abdominal hypertension, Abdominal compartment syndrome

INTRODUCTION

Abdominoplasty is a common aesthetic procedure done to refashion bulky anterior abdominal wall. The procedure was first described by Kelly in 1990.¹ Different techniques and modifications of abdominoplasty have evolved since then. It involves repair of one or combined repair of both these components. Rectus muscle plication as a component of abdominoplasty improves the aesthetic outcome along with repairing the rectus diastasis.² Mesh plasty alone in abdominoplasty is considered in patients with redundant fasciocutaneous component of abdomen without rectus abdominis weakness. According to

American Society for aesthetic plastic surgery data, abdominoplasty is one of the top five cosmetic surgical procedures performed in the United States.³

The tight abdominal closure in abdominoplasty causes rise in intra abdominal pressure (IAP). This leads to an array of physiological changes in pulmonary, cardiovascular, renal and visceral functioning.⁴ Hence, measurement of IAP is used to identify patients at risk of intra-abdominal hypertension and abdominal compartment syndrome after abdominoplasty.⁵ Early identification of significant abdominal pressure rise helps to take necessary measures to avoid potential

complications. The normal abdominal compartment pressure is between 0-5mmHg.⁶ The abdominal compartment syndrome is defined as intra abdominal pressure of above 20mmHg with dysfunction of at least one of thoraco abdominal organ.⁷ This comparative study was aimed to measure the IAP of patients in groups of meshplasty and abdominal wall plication, intraoperatively and post operatively.

METHODS

Study design

A comparative study of 34 patients who underwent abdominoplasty was conducted between January 2017 to July 2018 at department of general surgery, Amala institute of medical sciences, Amala Nagar, Thrissur, Kerala India. All patients undergoing abdominoplasty surgeries were included in the study. Patients with presence of intraabdominal malignancies or mass, patients with history of intra abdominal bowel adhesions, previous history of bladder surgery/trauma, neurogenic/dysfunctional bladder, and history of active urinary tract infection or pregnant ladies were excluded from the study. A written informed consent had been taken from the subjects.

Study procedure

Preoperatively, the patients were assessed clinically and radiologically, to assess soft tissue laxity, rectus diastasis, ventral hernia, defects in the linea alba and to rule out intra abdominal masses, malignancies or significant post void residual urine. The type of abdominoplasty was decided based on the skin and subcutaneous tissue laxity along with strength of abdominal wall musculature. Using the data of the previous study, Sd1=1.31(15); Sd2=1.50(6), mean difference of 1.89, power of 90% and α=0.01. The sample size was calculated using the equation given below;

$$n = 2Sp^2 [(Z1 - \alpha/2) + (Z1 - \beta)]/Md2$$

$$Sp = (Sd1+Sd2)/2$$

The number of samples was found to be 17 in each group. Abdominoplasty was done according to the standard procedure.⁸ The IAP was measured during the intra operative period and immediate post operative period by intravesical technique using Foley’s catheter.⁹ Briefly, a ramp with three stopcocks was connected to a conical connection piece at each side with a male/male adaptor and inserted. A standard intravenous (IV) infusion set was connected to a bag of 500 ml of saline and attached to the first stopcock. A 60-ml syringe was connected to the second stopcock and the third stopcock was connected to a pressure transducer via rigid pressure tubing. The system was flushed with normal saline. The patient in supine position, zero pressure module at the midaxillary line at the level of the iliac crest (mark for future reference) by

turning the proximal stopcock onto the air and the transducer. At rest, the three stopcocks are turned 'off' to the IV bag, the syringe, and transducer giving an open way for urine to flow into the urometer. To measure IBP, the urinary drainage tubing was clamped distal to the ramp, and the third stopcock was turned 'on' to the transducer and the patient. The first stopcock was turned 'off' to the patient and 'on' to the IV infusion bag; the second stopcock was turned 'on' to the IV bag and the 60-ml syringe. Aspirate 20-25 ml of saline from the IV bag into the syringe. The first stopcock was turned 'on' to the patient, and the 20-25 ml of normal saline was instilled in the bladder. The first and second stopcocks were then turned 'on' to the patient and thus turned 'off' to IV tubing and the syringe. The third stopcock already being turned 'on' to the transducer and patient allowed then immediate IBP reading on the monitor). Post operatively, drains were removed within a week or as soon as the drain volume reduces. Early ambulation, deep breathing exercises and regular wound dressings done in all patients.

Statistical analysis

Statistical analysis was done by using statistical software SPSS (version 16, IBM, US). Fischers test and Chi square test were used to compare the abdominal pressure changes in both the techniques of abdominoplasty, p<0.05 was considered significant.

RESULTS

The mean age was 49.65±10.48 years. The age wise distribution of patients was given in (Table 1).

Table 1: Distribution of age among the patients selected for mesh plasty and plication surgery.

Age (years)	Groups		Total
	Meshplasty	Rectus Plication	
≤30	1	1	2
31-40	1	1	2
41-50	6	11	17
51-60	5	4	9
≥61	4	0	4
Total	17	17	34

Fisher’s exact test p value=0.233

Fifty percent of the total patients were in the age group 41-50 years. None of the older patients underwent rectus Plication technique of abdominoplasty. No significant difference was evidence among the numbers in each age group. Among the total number of subjects in this study, 88.2% are females, and 11.8% males. Out of the total 34 cases, in 17 cases, mesh plasty and 17 cases rectus plication was done. Among total 34, 15 (44.1%) patients had associated co-morbidities. Nine out of 34 patients had diabetes mellitus; 4 patients had DLP; 5 patients had hypertension and 2 patients had CAD. However, no significant difference was found among the patients for

the co-morbidities in two groups (p=0.3000). Intra abdominal pressures measured intra operatively, in both techniques separately shows that 47.5% of the patients with grade I IAP were in the Mesh plasty group. 29.41% patients with grade I IAP were in the rectus plication group. Grade II IAP intraoperatively measured were more in the mesh plasty group: 17.64%. 2.94% of the patients in the Rectus plication group had grade II IAP. Only 1 patient in the study, had an Intra op IAP measurement between 20-25 mmHg, which was in the rectus plication group (Table 2). Intra op IAP monitoring in both techniques showed no significant difference among the groups (Fisher's exact test p=0.051).

Table 2: Intraoperative IAP in both techniques.

Intra operative IAP	Groups		Total
	Meshplasty	Rectus Plication	
Grade I	16	10	26
Grade II	1	6	7
Grade III	0	1	1
Total	17	17	34

Fisher's exact test p value=0.051

Post-operative IAP measurement in both techniques is given in (Table 3). Intra abdominal pressures measured post operatively, in both techniques separately shows that 29.411% of the patients with grade I IAP were in the Mesh plasty group. 20.58% patients with grade I IAP were in the Rectus plication group. Grade II IAP postoperatively measured in the mesh plasty group 17.64%. 14.70% of the patients in the Rectus plication group had grade II IAP. 17.64% patients had IAP measured above 20mmHg. Of these, 14.70% of the patients are in the rectus plication group. The IAP measured postoperatively, compared between the two study groups, is found to be insignificant (Fisher's exact test p=0.202).

Table 3: Post operative IAP measurement in both techniques.

Post operative IAP	Groups		Total
	Meshplasty	Rectus Plication	
Grade I	10	7	17
Grade II	6	5	11
Grade III	0	4	4
Grade IV	1	1	2
Total	17	17	34

Fisher's exact test p value=0.202

Postoperatively, all patients received DVT prophylaxis, deep breathing exercises and early ambulation were advised. Out of the 34 patients, 2 patients developed seroma formation which lasted for approximately a month after the drain removal. Thorough wound debridement done and was started on Antibiotics. Vacuum

Assisted Closure treatments with dressings were done. Minimal wound infection that subsided with oral antibiotics in 2 patients. 1 patient developed necrosis of the surgical wound. Wound healed with secondary intention. Post operatively, 1 patient developed sudden onset breathlessness and tachycardia on POD 3. The patient improved and was discharged within 2 weeks. Despite the complications, there was no post operative mortality, and all patients improved with satisfactory aesthetic outcome.

DISCUSSION

Findings of this study revealed that no significant differences in the measured variables including lung functions on comparing both types of abdominoplasty procedures. The findings are consistent to the previous study by Wilhelmsson et al.¹⁰ Twelve among the 34 patients had comorbidities such as DM, HTN or DLP. None of these patients had CAD, Respiratory symptoms or renal failure. Prophylaxis for pulmonary embolism (PE) and deep vein thrombosis (DVT) are important consideration. Furthermore, patients taking birth control medications or hormone replacement therapy are at an increased risk for DVT and PE.^{11,12} A personal or family history of DVT or PE also increases the risk. In such cases, preoperative laboratory analysis to evaluate the patient's coagulation profile including a factor V Leiden is recommended. Seroma formation is inherent part of healing in any abdominoplasty procedure. Only 2 patients in this study developed seroma formation which lasted for approximately a month after the drain removal. The use of smaller-diameter cannulas and minimal use of tumescent infiltration can help minimize the additional trauma.^{13,14}

The abdominoplasty, commonly referred to as a "tummy tuck," is a procedure to reduce the excessive skin and fat around the abdomen and strengthen the abdominal wall musculature. There are two important components of abdominoplasty aesthetic and reconstructive. The reconstruction is related to the need for reinforcement of musculoaponeurotic wall. The Meshplasty technique emphasizes the importance in the evaluation of the alterations of the skin, subcutaneous tissue, and musculoaponeurotic system of the anterior abdominal wall. A similar study based on 35 female patients outlines the guidelines for patient selection in approaches without rectus abdominis muscle placcation.¹⁴ In our study, 9 patients underwent meshplasty had associated Ventral hernias, repaired along with the procedure. Here, the patient presents with ventral hernia along with excess skin and subcutaneous tissue with no rectus diastasis.

Most of the studies have assessed the effect of abdominoplasty with rectus plication on IAP with variable results.¹⁵⁻¹⁷ Study confirm that the effect of rectus plication on increasing intraabdominal pressures, but also implicates bed position, binder placement, and general anesthesia as risk factors.¹⁸ A minimal increase in the

IAP is considered to be a physiologic response to incisional/ventral hernia repair. Further, small increases in IAP is also seen with positional changes, such as semi recumbent, lateral decubitus or prone positions. Healthy patients with infraumbilical striae, moderate amount of excess adiposity, skin and soft-tissue laxity, rectus diastasis or myofascial laxity are ideal candidates for full abdominoplasty. Patients with a BMI >35, may also be candidates, but would benefit from better preoperative weight management.^{19,20}

Based on the results obtained, it is not possible to conclude if plication of the rectus abdominis or mesh plasty generates significant physiological changes, such as an increase in IAP. Most of the patients who underwent Rectus plication in this study were healthy individuals with age above 50 years, less than 12% only. Careful patient selection, optimisation and risk stratified prophylaxis, have all shown to reduce complication rates drastically. Previous studies had demonstrated that rectus plication offers better aesthetic outcome with no mesh related complications.^{21,22} Abdominoplasty is associated with a risk of 1.1% of DVT which has been attributed to the intraabdominal hypertension after the procedure, known to cause decreased venous return, venous stasis, and thus thrombosis.²³ There is also decrease in ejection fraction and the cardiac output, along with reduction of lung volumes causing respiratory distress.²³ Based on this study, both mesh plasty and rectus plication causes minimal alterations in IAP, both intraoperatively and during the immediate post operative period. Intraoperatively, only 1 patient undergoing abdominoplasty (rectus plication) developed IAP of more than 20 mm of Hg. 76.5% of the patients had IAP below 15mm of Hg intraoperatively. Postoperatively, 50% patients had an IAP above 15 mm of Hg. Among them, 58.9% of the patients included in the rectus plication group (p=0.202). Though there are minor variations in IAP in both groups, a significant difference has not been established.

Limitations

Relatively small sample size and short duration were the major limitations of the study.

CONCLUSION

No significant intraoperative or postoperative IAP was found between the two study groups. Therefore, either meshplasty or abdominal wall plication techniques can be selected in subjects undergoing abdominoplasty.

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REFERENCES

- Kelly HA. Report of gynecological cases. *Johns hopkins Med J.* 1899;10:197.
- Cosmetic Surgery National Data Bank. Available at: www.surgery.org/press. Accessed on 14 October 2018.
- Cheatham ML. Abdominal compartment syndrome: pathophysiology and definitions. *Scand J Trauma Resusc Emerg Med.* 2009;17:10.
- Pereira N, Sciaraffia C, Danilla S, Parada F, Asfora C, Moral C. Effects of Abdominoplasty on Intra-Abdominal Pressure and Pulmonary Function. *Aesthetic Surg J.* 2016;36(6):697-702.
- Talisman R, Kaplan B, Haik J, Aronov S, Shraga A, Orenstein A. Measuring Alterations in Intra-Abdominal Pressure During Abdominoplasty as a Predictive Value for Possible Postoperative Complications. *Aesthetic Plast Surg.* 2002;26(3):189-92.
- De Keulenaer BL, De Waele JJ, Powell B, Malbrain MLNG. What is normal intra-abdominal pressure and how is it affected by positioning, body mass and positive end-expiratory pressure? *Intensive Care Med.* 2009;35(6):969-76.
- Malbrain ML, Cheatham ML, Kirkpatrick A, Sugrue M, Parr M, De Waele J, et al. Results from the international conference of experts on intra-abdominal hypertension and abdominal compartment syndrome. *Intensive Care Med.* 2006;32(11):1722-32.
- Grazer F. *Abdominoplasty.* McCarty JG, May JW, Littler JW, eds. *Plastic Surgery.* Philadelphia, Pa: WB Saunders; 1990:6:3929.
- Flesch-Thebesius M WK. Die operation des hangebauches. *Chirurg.* 1931;(3):372.
- Wilhelmsson S, Fagevik Olsén M, Staalesen T, Elander A, Nygren-Bonnier M. Abdominal plasty with and without plication-effects on trunk muscles, lung function, and self-rated physical function. *J Plast Surg Hand Surg.* 2017;51(3):199-204.
- Blickstein D, Blickstein I. Oral contraception and thrombophilia. *Curr Opin Obstet Gynecol.* 2007; 19(4):370-6.
- van Vlijmen EFW, Brouwer J-LP, Veeger NJGM, Eskes TKAB, de Graeff PA, van der Meer J. Oral contraceptives and the absolute risk of venous thromboembolism in women with single or multiple thrombophilic defects. *Arch Intern Med.* 2007; 167(3):282.
- Andrades P, Prado A, Danilla S, Guerra C, Benitez S, Sepulveda S, et al. Progressive tension sutures in the prevention of postabdominoplasty seroma: a prospective, randomized, double-blind clinical trial. *Plast Reconstr Surg.* 2007;120(4):935-46.

14. Marques A, Brenda E, Abramo A, Amarante M. Abdominoplasty without plication of the aponeurosis. *Eur J Plast Surg.* 1996;19(2):89-91.
15. Ghnnam W. Abdominoplasty for ventral abdominal hernia mesh repair AGORA (Antimicrobials: a global alliance for optimizing their rational use in intra-abdominal infections). Available at: www.jmj.org.ly. Accessed on 14 October 2018.
16. Gaidukov KM. Effect of intra-abdominal pressure on respiratory function in patients undergoing ventral hernia repair. *World J Crit Care Med.* 2013;2(2):9.
17. Angelici AM, Perotti B, Dezzi C, Amatucci C, Mancuso G, Caronna R, et al. Measurement of intra-abdominal pressure in large incisional hernia repair to prevent abdominal compartmental syndrome. *Edizioni Internazionali.* 2016;37(1):31-6.
18. Sugrue M, Buist MD, Lee A, Sanchez DJ, Hillman KM. Intra-abdominal pressure measurement using a modified nasogastric tube: Description and validation of a new technique. *Intensive Care Med.* 1994;20(8): 588-90.
19. Kim J, Stevenson TR. Abdominoplasty, liposuction of the flanks, and obesity: analyzing risk factors for seroma formation. *Plast Reconstr Surg.* 2006;117(3): 773-9.
20. Vastine VL, Morgan RF, Williams GS, Gampper TJ, Drake DB, Knox LK, et al. Wound complications of abdominoplasty in obese patients. *Ann Plast Surg.* 1999;42(1):34-9.
21. Tadiparthi S, Shokrollahi K, Doyle GS, Fahmy FS. Rectus sheath plication in abdominoplasty: Assessment of its longevity and a review of the literature. *J Plast Reconstr Aesthetic Surg.* 2012; 65(3):328-32
22. José Muaccad Gama L, Vinicius Jardini Barbosa M, Czapkowski A, Ajzen S, Masako Ferreira L, XerfanNahas F. Single-layer plication for repair of diastasis recti: the most rapid and efficient technique level of evidence. *Aesthetic Surg J.* 2017;37(6):698-705.
23. Huang GJ, Bajaj AK, Gupta S, Petersen F, Miles DAG. Increased Intraabdominal Pressure in Abdominoplasty: Delineation of Risk Factors. *Plast Reconstr Surg.* 2007;119(4):1319-25.

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