

Predicting safety during abdominal musculo-aponeurotic laxity repair by intra-operative monitoring of the Peak Inspiratory Pressure

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ABSTRACT

Abdominoplasty is one of the most commonly performed procedures in plastic surgery. Rectus plication in the repair of abdominal wall laxity as a main step in abdominoplasty causes extrinsic compression of the abdominal content and elevation of intra-abdominal pressure. Many methods were described to indirectly measure the intra-abdominal pressure, one of which is the peak inspiratory pressure. This study shows the efficiency of using the peak inspiratory pressure as a monitor during abdominal wall laxity repair. It also shows the safety of combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles in abdominal wall laxity repair.

Keywords: Abdominoplasty - Abdominal wall laxity – peak inspiratory pressure – intra-abdominal pressure

INTRODUCTION

The dynamic character of the abdominal wall can accommodate marked volume variations accompanied by changes in intra-abdominal pressure. Rectus plication in the repair of abdominal wall laxity causes extrinsic compression of the abdominal content and elevation of intra-abdominal pressure¹. Abdominoplasty as one of the most commonly performed procedure in plastic surgery has one of the highest incidences of deep venous thrombosis and pulmonary embolus among elective plastic surgical procedures; it is associated with a 1.1 percent risk of deep venous thrombosis and a 0.8 percent risk of pulmonary embolus. This is thought to be attributed to rectus plication causing intra-abdominal hypertension (pressure ≥ 20 mm Hg) which is known to cause decreased venous return and venous stasis and predispose to deep venous thrombosis^{2,3}. The three most reliable methods of indirectly measuring intra-abdominal pressure are gastric, inferior venacaval, and urinary bladder pressure measurements³. Another method of monitoring the increase in the abdominal pressure intra-operatively is the peak inspiratory pressure⁴.

The aim of this study is to detect the efficiency of intra-operative monitoring of the

peak inspiratory pressure after abdominal wall plication and to detect the safety of combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles.

PATIENTS AND METHODS

This randomized prospective comparative clinical study was conducted on 50 female patients complaining of various degrees of abdominal wall laxity, in the period from April 2011 to March 2013 at Kasr El-Ainy hospital for correction of abdominal wall laxity. Their ages varied from 27 years to 58 years (Mean age: 42.5).

The sample population was divided randomly into two equal groups according to the type of management of abdominal wall laxity; the first group was managed by vertical midline plication of the rectus sheath; the second group was managed by combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles.

The base peak inspiratory pressure was recorded at the start of each procedure and recorded again at the end of the plication.

In this study it was considered that the rise of the peak inspiratory pressure more than 12

cmH₂O than the base peak inspiratory pressure or to reach a total of 40 cmH₂O peak inspiratory pressure is considered unsafe to avoid post-operative complications

Statistical Analysis:

Data were statistically described in terms of mean \pm standard deviation (\pm SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student t test for independent samples. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

There were multiple variables in all the patients in the study including age, BMI, no. of

previous pregnancies and presence of abdominal wall hernias. All were compared as following:

Comparing the mean age of the two groups showed no significant difference at p value 0.298. Comparing the mean BMI of the two groups showed no significant difference at p value 0.077. Comparing the mean no. of pregnancies between the two groups showed no significant difference at p value 0.501. Comparing the percentages of presence of abdominal wall hernias between the two groups showed no significant difference at p value 0.648.

Analysis of the base peak inspiratory pressure:

- **Group (A):** The maximum was 17 cmH₂O, the minimum was 12 cmH₂O and the mean was 13.88 cmH₂O.
- **Group (B):** The maximum was 17 cmH₂O, the minimum was 13 cmH₂O and the mean was 14.41 cmH₂O.

Comparing the base peak airway pressure between the two groups showed no significant difference at p value 0.07079.

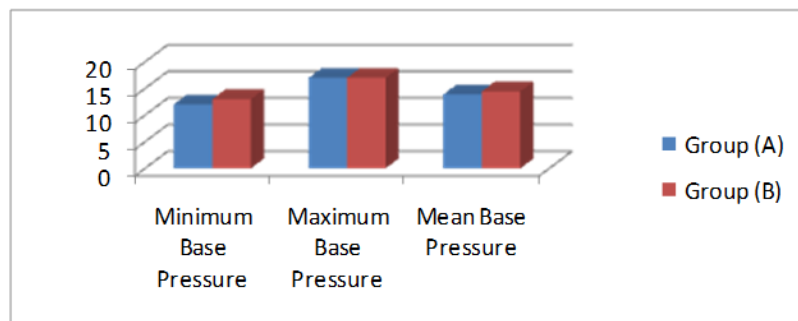


Fig.(1): A graph comparing the Base Peak airway pressure between the two groups.

Analysis of the post plication peak inspiratory pressure:

- **Group (A):** The maximum was 21cmH₂O, the minimum was 16cmH₂O and the mean was 18.28 cmH₂O.

- **Group (B):** The maximum was 23cmH₂O, the minimum was 17cmH₂O and the mean was 19.16 cmH₂O.

Comparing the postplication peak airway pressure between the two groups showed no significant difference at p value 0.0623.

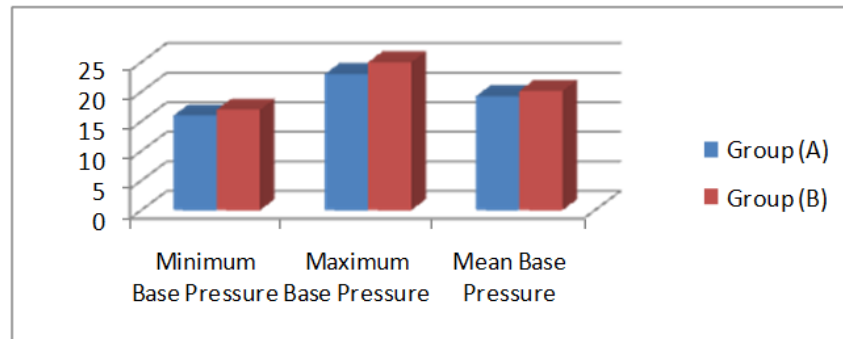


Fig. (2): A graph comparing the Post-Plication Peak airway pressure between the two groups.

In 6 patients whom the pre-operative decision was to perform a combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles after completion of the vertical plication the abdominal wall of so tight to perform the transverse plication as the peak inspiratory pressure (PIP) raised over 15-18cmH₂O than the base pressure in the trial to perform the transverse plication so in those patients the vertical plication was done alone and they were added to Group (A).

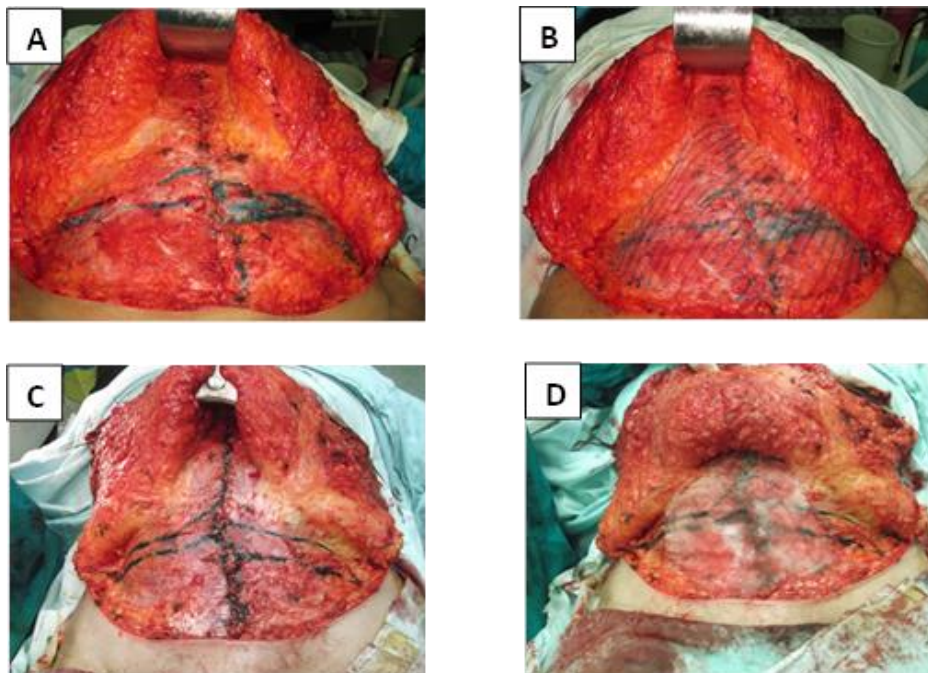


Fig. (3): (A & C) Showing two different patients whom the pre-operative decision was to perform a combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles after completion of the vertical plication the abdominal wall of so tight to perform the transverse plication, (B & D) showing that the transverse plication was not performed.

All patients in the study showed a smooth post-operative course after 6 months of follow up with no incidence of the complications caused by the increase of the intra-abdominal pressure as DVT, Pulmonary embolism and decreased respiratory compliance.

DISCUSSION

Abdominoplasty has one of the highest incidences of deep venous thrombosis and pulmonary embolism among elective plastic surgical procedures. When determining the safety of elective procedures, any amount of risk, especially of venous thromboembolism, is difficult to be accepted⁶. One of the main steps in abdominoplasty is the repair of the abdominal wall laxity which can cause a rise in the intra-abdominal pressure especially if there is a repair of a ventral or incisional hernia where the reduction of the hernia contents can cause more rise in the intra-abdominal pressure⁷.

The three most reliable methods of indirectly measuring intra-abdominal pressure are gastric, inferior vena caval, and urinary bladder pressure measurements³. Another method of monitoring the increase in the abdominal pressure intra-operatively is the peak inspiratory pressure; In a study by Frederick et al. in 2011 they stated that if the peak inspiratory pressure increased by more than 10 mmHg (13.6 cmH₂O) or if it was greater than 35 mmHg (47.6 cmH₂O), during the repair of large ventral hernias this is considered unsafe for the respiratory functions of the patients⁴. The peak inspiratory pressure is measured at the airway opening and is routinely displayed in mechanical ventilators⁵.

This study was conducted on 50 female patients complaining of various degrees of abdominal wall laxity, the sample population was divided randomly into two equal groups according to the type of management of abdominal wall laxity; the first group was managed by vertical midline plication of the rectus sheath; the second group was managed by combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles. The base peak inspiratory pressure was recorded at the start of each procedure and recorded again at the end of the plication.

The peak inspiratory pressure showed a safe, easy and effective method to detect the increase in the intra-abdominal pressure which can cause respiratory complications and the surgical decision had been changed intra-operatively in 6 patients in this study based on it to avoid post-operative complications.

When comparing the safety of the combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles, the large sample size in this study ensured that the multiple variables in the patients including age, BMI, number of previous pregnancies, presence of hernias and the mean base peak inspiratory pressure in all the patients did not affect the comparative result between the two groups and this was proved statistically when comparing the mean values of all these variables between the two groups.

Comparing the post plication peak airway pressure between the two groups showed no statistical significant difference meaning that this technique is safe provided that it is used in the indicated patients and the peak inspiratory pressure is monitored to avoid any over increase in the intra-abdominal pressure causing post-operative complications.

CONCLUSION

This study proved the efficiency of the use of the peak inspiratory pressure as an easy and safe indirect method to monitor any increase in the intra-abdominal pressure during the repair of abdominal wall laxity repair.

It also shows that the combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles is a safe technique that can be used in the indicated patients

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