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ORIGINAL ARTICLE

Is surgical plication necessary in diaphragm eventration?

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Summary *Background:* Diaphragm plication surgery is conducted to remove dyspnea, which results from mediastinal shift, atelectasia, and ventilation/perfusion dyssynchrony in lungs that occur because of an eventrated diaphragm. This study aims to determine whether diaphragm plication has any effect on respiration by analyzing the patients' changing values in the respiratory function test (RFT) after plication surgery.
Methods: Sixteen patients who underwent diaphragm plication surgery in our clinic because of plication eventration or paralysis were examined prospectively. Diaphragm eventration values were assessed using a calculation method that uses posteroanterior pulmonary radiographies taken during patient admission and control; then, these data were recorded. The amount of changes in the eventration levels and in restrictive respiratory failure parameters—forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC) of RFTs—conducted in pre- and postoperative control periods were compared using statistical analysis methods. The compatibility between the amounts of RFT changes was examined through a satisfaction survey—using a questionnaire that consisted of multiple choice questions with answer options such as "better," "the same," and "worse"—to understand preoperative and postoperative symptom levels in the 12th month of postoperative control.
Results: According to postoperative levels, a decrease between 19% and 23% was observed in eventration amounts within the 1st postoperative month, 6th postoperative month, and 12th postoperative month. In addition, the highest average increase in FEV1 liter (lt) values was 0.2 lt and 0.25 in FVC (lt) values.
Conclusion: Researchers of this study believe that more distinctive decisions need to be taken while identifying patients for surgery in unilateral diaphragm eventrations, especially in the

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adult patient group; surgical option should be used for cases in which the eventrated diaphragm results in mediastinal shift and respiratory failure.

1. Introduction

During calm respiration, approximately 75–80% of air is taken into the lungs because of diaphragm fibrillation. Each 1-cm vertical action of the diaphragm leads to shifting of 300–400 cm^3 air.

Previous cardiac–thorax mediastinum surgery, trauma, neuromuscular diseases, infective cases, and malignity are believed to be causes of diaphragm eventration. In idiopathic cases, mostly viral factors are the main sources. Unilateral diaphragm eventration/paralysis does not necessarily exhibit any clear symptom in adults; however, bilateral diaphragm paralysis leads to the development of respiratory failure.

Although eventration manifests itself via respiratory distress, it is not symptomatic in every case. It is detected incidentally in a pulmonary radiography taken for another disease. So far, most of the studies on diaphragm eventration and surgical treatment offer subjective results. Some analytic studies have raised discussions about indications of surgical treatment. In this study, a total of 16 individuals who underwent an operation in our clinic because of diaphragm eventration and followed up for 1 year were examined prospectively. The eventration level of individuals was determined with the calculation method of the study group. The obtained results were compared with the values of restrictive respiratory failure parameters: FEV1 (forced expiratory volume in 1 second) and FVC (forced vital capacity). The data compiled from these results were evaluated within the scope of the existing literature.

2. Material and methods

A total of 16 patients who underwent diaphragm plication surgery in our clinic because of plication eventration or paralysis were examined prospectively between March 2009 and December 2012. Diaphragm eventration levels were calculated via a new calculation method through posteroanterior (PA) pulmonary radiographs taken during patient admission. Hemidiaphragm positions were detected by PA pulmonary radiography during patient control periods performed 1 months, 6 months, and 12 months after the operation. Through this method, the difference between preoperative and postoperative diaphragm levels was recorded. The amount of change in eventration levels and in restrictive respiratory failure parameters (FEV1, FVC) of respiratory function tests conducted during pre- and postoperative control periods were compared using statistical analysis methods. In this way, the effect levels of eventration changes on RFT were assessed. A survey using the symptomatic condition questionnaire—which featured answer options such as "better," "the same," and "worse" toward preoperative and postoperative symptom levels in the 12th month of postoperative control—was conducted. The compatibility between responses and the amounts of RFT changes was examined.

Using PA pulmonary radiography, the distance between the peak of the intactus hemidiaphragm and apex point of the ipsilateral hemithorax was measured with this new method. (1) Similarly, the distance between the peak of the eventrated hemidiaphragm and the apex point of ipsilateral hemithorax was measured. (2) The ratio of B/A and eventration level was calculated as a percentage (Figure 1).

Example:

$A = 25$ cm, $B = 20$ cm

$$100 - \frac{100 \times B}{A} = 100\frac{100 \times 20}{25} = 20\%$$

In the postoperative period, measurement was made using the same formula according to the last position of the plicated hemidiaphragm. The difference between postoperative and preoperative values was calculated, and the contribution of the plication operation on the diaphragm level was calculated (Figure 2).

Example:

$A_1 = 25$ cm, $B_1 = 22$ cm

$$100 - \frac{100 \times B_1}{A_1} = 100\frac{100 \times 22}{25} = 12\%$$

Diaphragm eventration difference in preoperative and postoperative period: 8%.

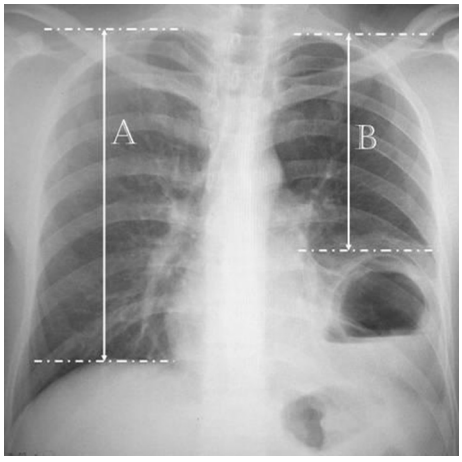

Figure 1 Preoperative chest X-ray.