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New possibilities in Pectus Excavatum

Robert Chudzik[1], Katarzyna Jarosz-Chudzik[2], Maria Gołębiowska[3], Beata Gołębiowska[4], Marcin Kulczyński[5]

[1] Independent Public Clinical Hospital No. 4 - robertch7@gmail.com

[2] Student II Faculty of Medicine with English Language Division, Medical University of Lublin

[3] Student I Faculty of Medicine with Dentistry Division, Medical University of Lublin

[4] Pediatric Neurology Department, III Chair of Pediatrics, Medical University of Lublin

[5] Chair and Department of Neurology, Medical University of Lublin

Abstract

Pectus Excavatum is one of the most frequent deformations of the chest wall, diagnose and surgical treatment mainly in pediatric patients (1:300 - 1:1000 live births). More often in men than in women, the etiology of this disease is not entirely clear, probably multifactorial.

The aim of the study was to analyze the current literature regarding the surgical treatment of pectus excavatum and to indicate new treatment options.

For the purpose of this study, we analyzed the current papers on pectus excavatum found in the PubMed database.

The Ravich and Nuss procedure remains the basic way to treat pectus excavatum, and over the years both methods have found their supporters. The work focused on the improvement of both of these methods, however, mainly the Nuss Procedure was considered, because of being minimally invasive. Attention was also paid to the possibility of simultaneous implementation

of both methods and advantages of this way for the patients. The new possibilities concern not only the surgical techniques itself, but also the new technical possibilities used in surgery. Nowadays, the scientific focuses on improving currently used methods by reducing operational risk, shortening the time of surgery, and thus improving patient safety and, of course, improving its quality of living. Most likely, with the development of technology, further options will be adapted to the treatment of Pectus Excavatum.

Keywords: Pectus excavatum, Ravich, Nuss

Introduction

Pectus excavatum and Pectus Carinatum are the most common congenital chest wall deformities (1:300 - 1:1000 live births). In both cases, pathogenesis is not entirely clear, despite numerous hypotheses. Probably etiology is multifactorial. The occurrence of deformities in men were more frequent than in women, but the diagnosis in women can often be neglected, due to the breast tissue.

Usually, the exclusion of a connective tissue defect is the reason for referral for genetic diagnostic. A detailed family history is needed as well as a complete physical examination. If no abnormalities are detected, then pectus excavatum / carinatum can be considered as an isolated deformity and it does not appear that further genetic testing is needed. Although pectus excavatum / carinatum with a positive family history of Mendel's inheritance has been described, it is possible that these origins represent multifactorial inheritance, as the genetic cause of the isolated familial pectus excavatum / carinatum has not yet been described. The recurrence risk for non-family isolated pectus excavatum / carinatum is unknown, but is considered to be low. If other symptoms are found, further diagnostic tests are recommended, because pectus excavatum / carinatum can be part of many syndroms. However, the most important and most frequently observed monogenic syndroms from pectus excavatum / carinatum are Marfan's syndrom and Noonan's syndrom. [1-3]

To assess the degree of chest deformity, we can use, for example, the Haller Index, which is used to describe the internal dimensions of the chest. We assess the ratio of chest width and height measured from the axial CT scan. Physiologically, the Haller index should be around 2.5. Chest wall deformities, such as pectus excavatum, can reduce the distance between the sternum and the spine, thus increasing the rate that can reach 3.25 or even 5.5. In extreme cases,

the value can reach up to 30, which also involves heart compression. However, it is not possible to assess the Haller Index in all cases. An example may be a situation in which the computed tomography of the chest shows, depression of the sternum is posterior to the anterior surface of the spine, which makes Haller index unmeasurable. [4-7]

Besides of the severity form, Pectus Excavatum worsens the quality of life. In the case of a mild form, it can only be a cosmetic problem, which, however, is reflected in the functioning of the patient. Lowering self-esteem and thus worse functioning in society. Or in a more severe form when dealing with somatic symptoms, among others with worsening of physical exercise tolerance, shortness of breath. The cross-section of diseases that can be caused by chest deformation is quite wide: arrhythmias, chest pain, secondary spinal deformities. [3,8]

The main methods used in the treatment of Pectus Excavatum are surgical methods. Two of the most well-known methods of treatment is Ravich's operation, which involves making a long cut on the front chest wall, shortening the rib cartilages and sternum plasty. The second one is the Nuss procedure, which consists in inserting one to three chromium-nickel or stainless steel bars under the sternum, after which the collapsed sternum is pushed against the level of protruding ribs, reducing deformation. As a result, allergy testing is now routinely done prior to surgery. In the event of an allergy, a titanium bar will be used. The cuts are made in the axillary line about 2 cm long, the bars are removed after about two years from their insertion. Both methods are currently in use, there are numerous studies comparing these methods. We can conclude that there is no difference in length of hospitalization or complications, however, after the Nuss procedure, the patient more often required reoperation or hematoma in the pleural cavity. On the other hand, the time of surgery and blood loss is lower in the Nuss procedure. [3, 9, 10]

Another method, as the only non-surgical, is the use of a vacuum belt, however, this method is not entirely sure when it comes to its results. [11]

In previous studies, the focus was on highlighting the effectiveness and advantages of both methods - each of them found its supporters, while in comparative studies in both methods the results were similar. However, it seems that the Nuss procedure as a minimally invasive method has found wider application in both pediatric and adult patients. [10, 12, 13]

Due to the advantages of the methods used so far in recent years, the research focused mainly on attempts to improve them with the only exception, which was the simultaneous application of the Ravich and Nuss procedures. The method is effective especially for asymmetrical and complex deformations. [14, 15]

The modified Nuss procedure, ad modum Pilegaard is a method that, compared to its original, is faster and more securely stabilizes the chest. In addition, it is less painful for the patient and in most cases improves cardiac performance. [16]

Double compression and complete fixation-double bar is another modification of the Nuss procedure, this time thanks to the use of two plates - one above and the other under the sternum, it allows to avoid complications likes plate displacement. According to the authors, it also shortens the time of surgery and time of hospitalization. It is a method for surgery of both pectus excavatum and pectus carinatum [17,18]

Another method of supplying pectus excavatum is to protect the deformation with a sternum plate placed through an inframammary incision made horizontally crossing the mid sternal line. This method was used successfully in adult patients who had not previously been operated on due to deformity. [19]

Even the simple change of the patient's position to the Nuss procedure and the change in the location of the optics can supply benefits during the operation. Another proposed change is placing the patient's hands along the body instead of at a 90-degree angle and placing the optics above the cut. This change will improve the operating conditions facilitating the surgery and make it safer for the patient.[20]

Novelties in the surgical treatment of chest deformities do not only apply to the surgical technique itself but also to the use of new technical possibilities. The use of cryoanelgesia of intercostal nerves is an option to reduce pain in the postoperative period. The use of cryoablation reduces the need for analgesics. [21]

Probably with the appearance of new possibilities, the surgical technique in case of chest deformation will continue to evolve. Due to the lack of unambiguous answer to the question of what is the etiological factor, symptomatic treatment and corrective surgery remain. The aim of improving the currently used methods is to reduce the operational risk, shorten the time of surgery, and thus improve the patient's safety and, of course, improve his quality of life, not only in the long-term, but also by reducing the pain accompanying the surgical procedure.

Numerous studies show that despite the risk associated with surgical operations, it is reasonable to undertake operational intervention in case of chest deformation. This applies not only to improving lung function, but also to improving the quality of life. We can see long-term results after surgery, improvement of patients' self-assessment and their functioning. [22,23,24,25]

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