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Chapter 3

Trends in the treatment of pectus excavatum in the Netherlands



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Under review

Abstract

Introduction

Pectus excavatum (PE) is the most common deformity of the anterior chest wall and can be corrected surgically with different techniques. In the past years medical literature suggests that the minimal invasive surgical correction of PE (MIRPE), has currently become the operation technique of choice in Europe and the number of PE patients undergoing surgery has increased. The aim of the study was to evaluate trends in the number of patients operated on and the surgical techniques generally used in patients with PE in the Netherlands.

Materials and Methods

From the registration by Statistics Netherlands, the numbers of live births and gender were obtained for the period 1980-2017. Furthermore from the Dutch hospital registration performed by Kiwa - Prismant systems, the number of total surgical procedures of pectus excavatum patients from the period 1998-2017 and the numbers of open and MIRPE surgery were obtained over the period 2005-2013.

Results

The birth rate in Netherlands has stayed more or less stable in the last decades. The number of PE patients asking for correction however has increased. In addition the percentage of thoracoscopic assisted correction has increased.

Conclusions

The increase in correction of PE is not due to an increased incidence but to an increase of patient wishes. The use of MIRPE is gaining popularity over time.

Introduction

Pectus excavatum (PE), also called funnel chest, is the most common deformity of the anterior chest wall. The deformity can be present at birth, but more frequently becomes more prominent or visible in puberty, during the period of rapid physical development. The specific cause of the manifestation of the pectus excavatum is not fully understood. In practise the costochondral formation between rib and sternum shows exuberant growth. This leads to an inward position of the anterior chest wall whereby the sternum transfers backwards. Since pectus excavatum is also frequently present in family members (35-45%), there also is a genetic component for PE [1]. There is an association with tissue abnormalities such as Marfan's syndrome, which occurs more frequent in this patient group.

Although pectus excavatum was regarded as a deformity which mainly gave limitations of respiratory function or cardiac function in the past, nowadays it is mostly seen as a cosmetic problem. The depth of the sunken sternum can be expressed using the Haller index, which is the ratio of the shortest horizontal distance measured on the inside of the rib cage and the shortest distance between the sternum and the front of the thoracic spine. (normal value ± 2.5) [2]. A deep pectus excavatum may have a negative effect on respiratory and cardiac capacity and a more superficial deformity mainly causes a cosmetic problem. Unfortunately, studies are not conclusive about the improvement on pulmonary and cardiac function after surgery [3,4].

Patients with a PE show a lower self-esteem compared to their peers influencing their development during adolescence and thereafter[5]. Physical complaints such as localized rib or sternum pains may also influence their social behaviour.

Treatment of PE is still mostly surgical, although small superficial PE can also be treated conservatively or with specific muscle strength training. Another possible solution is a local implantation of a custom made silicon prosthesis, but the incidence of seroma formation around the prosthesis remains high and it is more suitable for less severe cases at an adult age. [6]. Furthermore external devices such as Vacuum Bell can be used. These consist of a vacuum system placed over the PE for part of the day. Its success is largely dependent on patient compliance and motivation and the permanence of correction is unclear [7]. The most commonly used surgical techniques of a PE include the open Ravitch technique and the minimally invasive Nuss procedure (MIRPE). Both surgical

techniques provide good cosmetic result [8]. There are other less frequently used surgical techniques as the Pectus-up or Magnetic mini-mover procedure. In these procedures a device is screwed into the sternum and locked onto the front ribs or 2 magnets are used to correct the pectus [9,10].

The Ravitch technique was introduced in 1949 and includes partial removal of the cartilage next to the sternum, release of the sternum itself and reposition of the sternum with sutures, metal strut or mesh material. This technique has been modified over the years, whereby the incisions have been minimalized. It is characterized by fewer serious complications and less post-operative pain compared to the Nuss procedure [11].

The Nuss procedure was developed around 1987. In this minimally invasive surgical procedure there are one or more pre bend metal bars inserted into the chest behind the sternum and resting on the lateral ribcage. The bar thus pushes the sternum forward to correct the anterior wall deformity. The procedure is usually done under thoracoscopic control and sometimes combined with temporarily lifting per-operative of the sternum by crane technique or Vacuum Bell. The bar(s) stay in situ for a least two to three years, to minimise the risk of recurrence, when they are removed. The technique was introduced in the Netherlands in 1999 [12]. Although serious complications are not frequent, they can be life threatening [13].

In the last years, in the international medical literature, there was a fair number of publications about minimal invasive surgical correction of the PE, about its successes, but also about its serious risks. Despite that, it appears that the Nuss procedure has become the first choice as surgical technique, instead of the Ravitch procedure in Europe and the number of PE patients undergoing surgery seems to increase. Unfortunately there is little exact data about the numbers of patients with PE treated around Europe. The only publication is from a short term registry in the United Kingdom, showing a number of 175 MIRPE procedures performed in a 3 year period [14]. In the Netherlands, there are so far no clear data published neither on numbers of surgery nor preferred technique.

Our hypothesis is that there is an increase in the percentage of children with PE who are operated upon. Next to that minimal invasive placement of the Nuss bar has become the new standard instead of the Ravitch in the Netherlands in patients with PE.

Materials and Methods

The number of children born in the Netherlands are registered by Statistics Netherlands. Trends in live births and gender, were obtained. The transaction codes of nearly all Dutch hospitals (maximum 95) are registered in the Kiwa - Prismant system. The trends in the number of total surgical procedures in pectus excavatum patients, were acquired over the period 1998-2017. The numbers on open and minimally invasive pectus excavatum surgery were obtained over the period 2005-2013.

Results

In the Netherlands, the number of total live births in the Statistics Netherlands registration decreased slightly in the period 1980-2017. The ratio between born boys and girls has not changed much during this period (Fig 1).

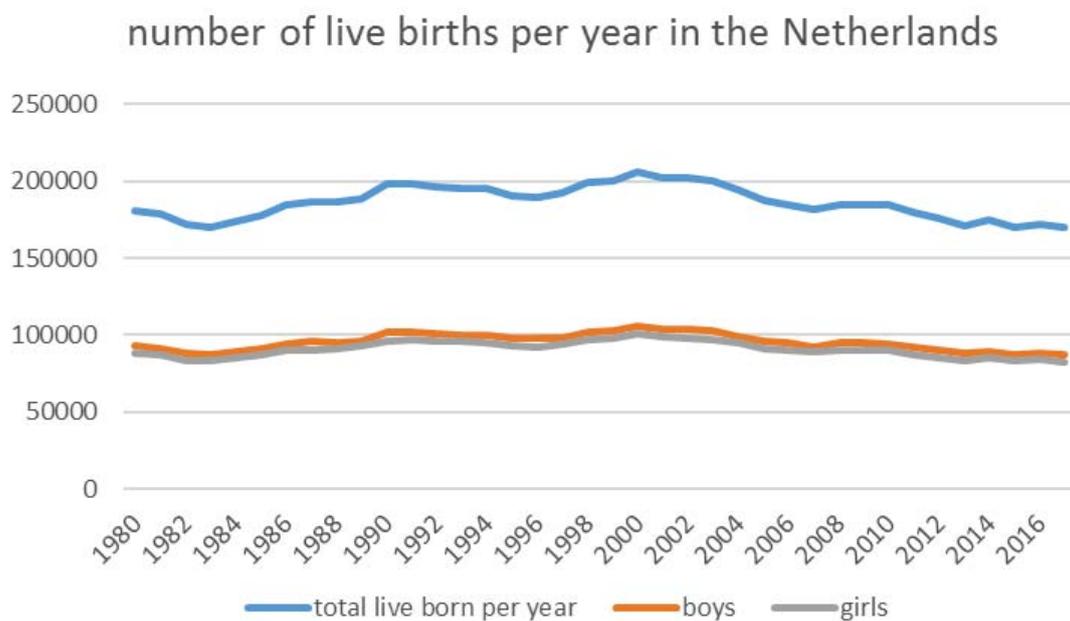


Fig 1. The number of live births per year in the Netherlands over the period 1980-2017.

Congenital abnormalities of the chest are not recorded centrally in The Netherlands. There is however a national register for diseases leading to hospital treatment. The Kiwa - Prismant registration of surgical treatment of pectus

patients does not include all hospitals (77 of 95) in The Netherlands, but makes an estimation of operative correction possible from 1998.

Over the course of the years 1998-2017, we see an increase in the surgical corrections of patients with a pectus excavatum disorder. There is an absolute increase, as well as an increase in the thoracoscopic assisted minimally invasive surgery measured over the period 2005-2013 in pectus excavatum patients (Fig 2).

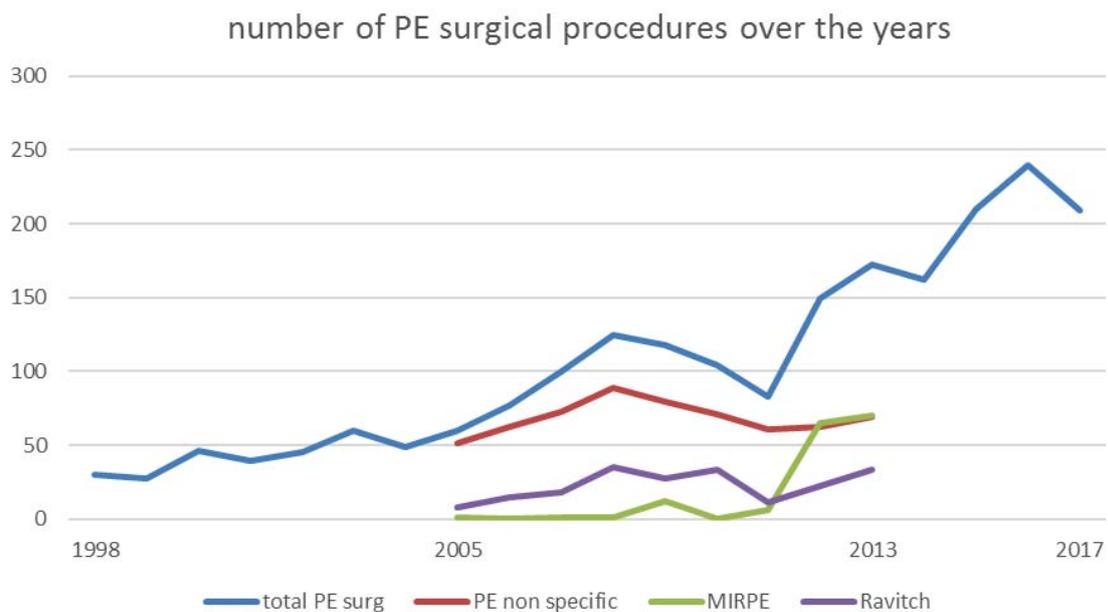


Fig 2. The number of performed PE surgical procedures per year (period 1998-2017) and the type of surgery (period 2005-2013).

When we measure the total number of PE correction surgery per year against the number of live births per year with adjusting for correction age at surgery at 16 years, there is an upward trend. Showing the increase of PE surgery from one in more than 6000 to one in less than thousand live births (Fig 3).

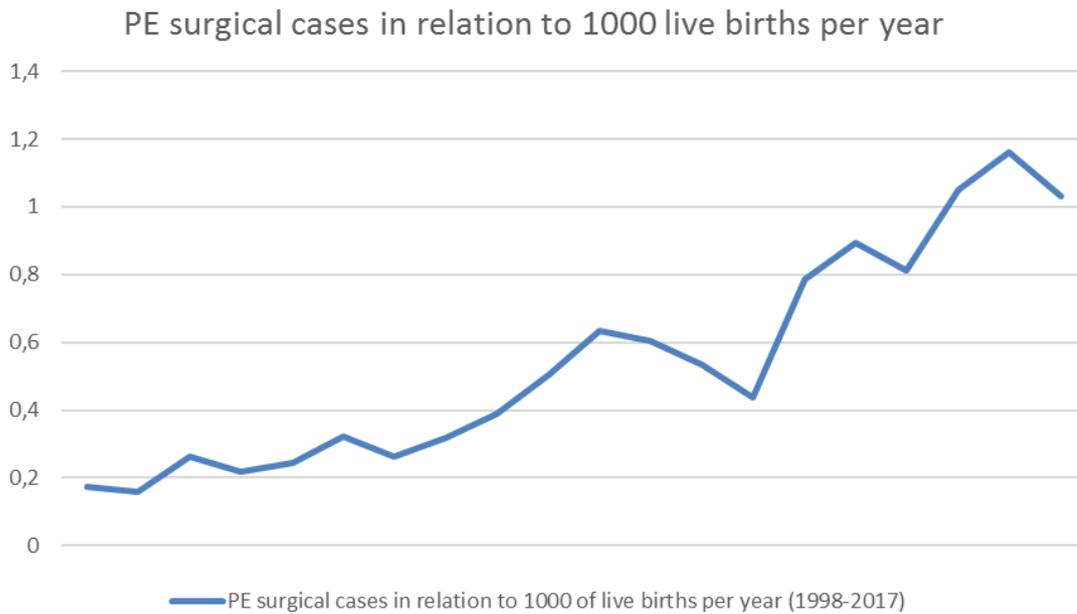


Fig 3. PE surgical cases per 1000 live births per year (1998-2017)

Based on a median operative correction age of 16 years and corrected for the live births of 1982 till 2001.

Discussion

Pectus excavatum is the most common congenital chest defect (90%). The incidence of pectus excavatum in adolescents has been estimated between 0.1 and 0.8 per 100 persons [15]. Pectus excavatum appears to be more common in Caucasian people, but specific data is missing. In the Netherlands there is also no central registration of babies born with pectus excavatum, there is however a registration of operative transaction codes of Dutch hospitals. The continuing data of more than 80 percent of Dutch hospitals is recorded for performed pectus excavatum surgery.

In the last decades there is a decline in the number of births. This will by itself lead to an absolute reduction of children with a PE in the future. Since the average age of patients undergoing pectus surgery in the Netherlands is 16 years, we should however look at the births rates before 2001, which were fairly stable. If we look at the amount of operations performed for PE, there is however a steady increase over the years. This has led to a lower number of births per surgical case from above 6000 per case in 1998 to less than thousand in 2017.

Since the increasing total number of operations for PE is not caused by changes in number of live births per year, it is most likely caused by other factors. In the Netherlands there is an ongoing upward trend towards increased use of cosmetic procedures [16]. Reasons may be the better acceptance of having cosmetic surgery, or because children experience more physical limitations than is realised and therefore seek surgical treatment of their PE.

The use of the minimal invasive correction technique for PE is also increasing over the years. This preference might be caused in an appearance conscious society and the expectance of smaller scars after MIRPE than after a Ravitch procedure. However, if we look at the number of live births and adjust for the in the literature mentioned incidence, we would expect a much higher level of patients coming forward for operative correction of their pectus excavatum, than is the reality at the moment (Fig 4).

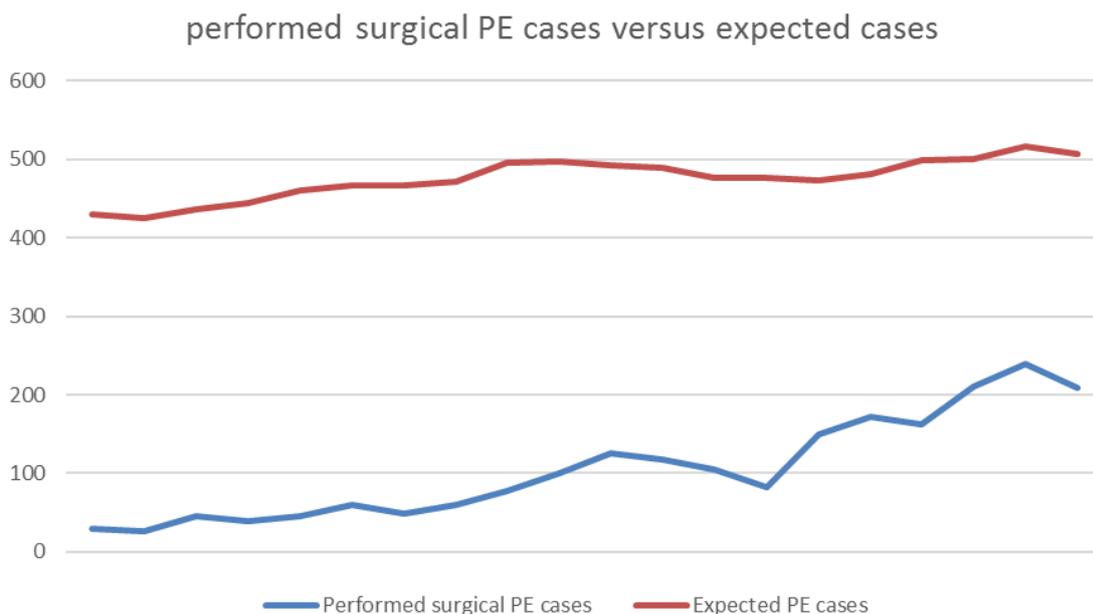


Fig 4. The number of performed PE operations versus the number of expected PE cases (1998-2017)

Expected cases based on incidence 1:400

The latter can be caused by ignorance of the possible surgical treatments of the public or a large portion of patients with mild PE abnormalities.

Conclusion

There is an increase in total performed surgical corrections of patients with a pectus excavatum over the last 2 decades, as well as a steady increase on the part of minimal invasive reconstruction of the pectus excavatum.

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