



E-ISSN: 2616-3470

P-ISSN: 2616-3462

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2022; 6(4): 08-10

Received: 11-07-2022

Accepted: 16-08-2022

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## Death cases related to Nuss procedure

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DOI: <https://doi.org/10.33545/surgery.2022.v6.i4a.942>

### Abstract

Nuss procedure is a revolution of pectus excavatum treatment, however, it has fatal complications. Because few surgeons are willing to report their own death cases, there are almost no relevant reports in the literature. Through private communication with peers, we learned lots of information about such death cases.

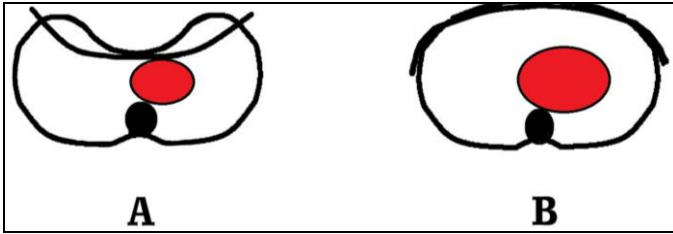
**Keywords:** Pectus excavatum, Nuss procedure, complication, death case, Wang procedure

### Introduction

Pectus excavatum is the most common thoracic deformity, and Nuss procedure is considered to be the greatest surgery for this deformity [1]. As this operation has the advantages that all previous operations do not have, it quickly became popular around the world once reported [1, 2]. However, this operation is not perfect. In addition to common complications, the most worrying problem is the risk of the operation [3, 4]. Its biggest risk is injury to the heart (Fig. 1). Once the injury occurs, almost all patients will die. This risk is a reality that many surgeons know. Because of this, many surgeons almost dare not do this operation. Contrary to this reality, there is almost no report of death case in the literature [1- 4]. The results shown in the literature obviously do not reflect the real risks. In the past ten years, I have performed pectus excavatum surgeries in more than 300 hospitals in China [5]. During the private interviews with local surgeons, I learned a lot about some rarely known death cases. This gave me a more comprehensive understanding of the risks of this operation. In general, the death cases related to Nuss procedure include three kinds: (1) death cases in Nuss procedure; (2) death cases after Nuss procedure; and (3) death cases in the removal operation of steel bar. Three kinds of cases are introduced as follows.

### Death cases in Nuss procedure

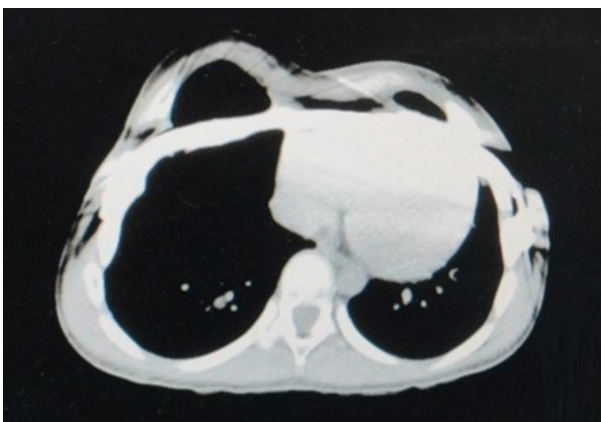
In the past 10 years, I have heard 31 such cases totally. These cases all involve heart injury, mainly heart rupture. Except 2 cases were successfully rescued, all others died in these cases. The reason for this risk is generally believed to be related to the surgeon's skills. If the surgeon cannot skillfully complete the operation of placing the steel bar, the risk may occur at any time (Fig. 1). In order to avoid such risks, many special technologies and devices have been designed [1, 3, 4], but the final results are not satisfactory, and tragedies continue to occur. In addition to the risk of heart rupture, there is another risk that is often overlooked, that is, the impact on the heart rhythm. During the placement of the steel bar, the introducer and the steel bar are always touch or even oppress the heart, which may affect the rhythm of the heart at any time. In severe cases, it may lead to ventricular fibrillation directly. If the patient is not treated properly, it can also lead to death. I've heard of 3 such caeses, 2 of which died, and one recovered after rescue, but the operation for pectus excavatum was canceled. I myself have experienced such a case. The patient was a 13-year-old male pectus excavatum patient. During the placement of the introducer, ventricular fibrillation suddenly occurred. I had to stop the operation and perform to external massage and electric shock defibrillation. The patient was rescued, but the operation could not continue. In the above two kinds of death cases, the root cause was the impact of the placing the steel bar on the heart. Obviously, if no steel bar is placed, or if no steel bar is placed on the surface of the heart, these kinds of case will hardly happen



**Fig 1:** Nuss procedure diagram. A, The steel bar needs to be placed on the surface of the heart, so the risk of heart damage cannot be avoided; B, After the anterior chest wall is propped up by the steel bar, the cardiac compression is relieved theoretically. However, if there is a problem with the placement of the steel bar, it will not only fail to eliminate the compression, but also cause new compression from the steel bar on the heart

### Death cases after Nuss procedure

This is an extremely rare case of death related to Nuss procedure. I have only heard of one case, which was told to me by the surgeon himself. This patient is a 15-year-old male. After Nuss procedure on pectus excavatum, the appearance of chest wall basically returned to normal, the depression disappeared, and the patient recovered well. Unfortunately, tragedy happened one night a year after the operation. The patient likes playing video games, and he is a very diligent player. He played very late that night. When his family found him the next day, he had already died for a long time. The patient's ultimate cause of death was determined to be overwork. From a medical point of view, this explanation can only be regarded as an inducement, and the real reason may be others. We have seen many imaging examinations after Nuss procedure, and one of the signs is often ignored. That is the compression of steel bar on the heart (Fig. 1B, 2). This condition is invisible on the chest wall surface of patients, but it often exists. In fact, the compression of the steel bar on the heart is no less than that of the depression chest wall of pectus excavatum itself, sometimes even more serious. Obviously, this kind of oppression is a potential danger of sudden death. On this basis, if overwork or other events occur, misfortune will inevitably occur. It can be seen that in this death case, the position where the steel bar is placed is the real culprit.



**Fig 2:** Signs of heart compression by steel bar in the failed Nuss procedure.

### Death cases in the removal operation of steel bar

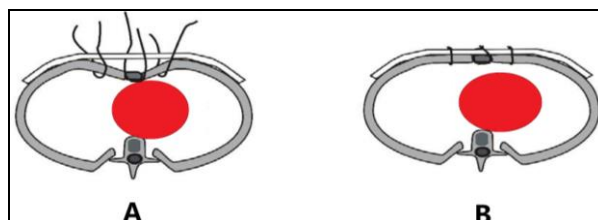
Nuss procedure requires the placement of steel bar in the body. Since such steel bar cannot remain in the body eternally, they need to be removed after a specific time [2]. The operation of

removing steel bar is generally considered to be an extremely simple operation, and some people even think that the steel bar can be removed through local anesthesia in the outpatient department. In the past, we have completed thousands of steel bar removal operations. We feel that the bar removal is not a simple operation, and sometimes it is even fatal. We have heard of two death cases related to this removal operation, one from a famous hospital in the north and the other from a famous hospital in the middle in China. The details of the cases are not very clear, but it is obvious that the hearts were severed, leading to massive bleeding, and finally died of hemorrhagic shock. Obviously, this kind of death case is also caused by the placement of steel bar. If the bar is not placed on the surface of the heart, the fatal complications of bar removal will not occur.

From the above introduction, it can be seen that the death cases related to Nuss procedure are not rare, but such reports are hardly seen in the literature. This is actually a direct reflection of human nature. People like to show their virtue, and no one will deliberately show their defects to others. Surgeons are human beings, so they will make the same choice. They always share their good experiences in the literature, and few people are willing to report the failure cases. The death cases of Nuss procedure can be regarded as a direct reflection of surgeons' skills. Such death cases are almost equivalent to scandals, so no surgeon will take the initiative to report such scandals. Because of this, the death cases related to Nuss procedure are almost all hearsay, and there is no direct report.

My department is the first independent chest wall surgery department in the world [5, 6]. Our work is to complete the surgical treatment of various chest wall surgical diseases. These diseases include tumor, defect, trauma, infection and deformity of chest wall [5, 6]. Among them, deformity surgery is the most work we have completed. In the deformity surgery, pectus excavatum surgery is the most frequent. In the early years, we used the classic Nuss procedure. However, like other peers, we soon realized the risk of this surgery, so we began to improve it. Later, we gradually designed the Wung procedure [7] and Wang procedure [8], the safety index of which was significantly higher than that of Nuss procedure. We also designed a very simple technique for fixing steel bar, namely Wang technique [9]. In the past work, we have completed thousands of pectus excavatum operations without any death. However, we have met many domestic counterparts. In some private interviews, I learned many fatal cases. These hearsay cases have deepened my understanding of the risks of Nuss procedure.

The death cases related to Nuss procedure described above were not reported at all. I knew them from two ways: one was the surgeon himself, and the other was the fellow surgeon. Although its credibility is questionable, it has at least some reference value. These cases can prove the real risk of Nuss procedure. The cause of the risk is superficially related to the doctor's technology, but the essential reason is the location of the steel bar. It can be assumed that if the steel bar does not need to be placed on the heart surface, all related fatal complications will not occur [8]. This is obviously the biggest regret of Nuss procedure. Fortunately, we designed a new operation, namely Wang procedure [8, 10]. In this procedure, the bar is placed on the shallow surface of the depression (Fig. 3). Since the bar no longer contacts the heart, all risks associated with Nuss procedure were completely eliminated. This may be the ultimate solution to eliminate the death risks of Nuss procedure.



**Fig 3:** Wang procedure diagram. A, The steel bar was placed on the shallow surface of the depression, and the structure of the depression was lifted by several steel wires. B, After the depression structure was lifted and fixed on the steel bar, the deformity was completely corrected. Since the bar does not contact the heart, Wang procedure is safer than Nuss procedure relatively.

### Conflict of Interest

Not available

### Financial Support

Not available

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#### How to Cite This Article

Wang W, Long W, Liu Y, Cai B, Luo J. Death cases related to Nuss procedure. *Int J Surg Sci* 2022;6(4):08-10.

DOI: <https://doi.org/10.33545/surgery.2022.v6.i4a.942>

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