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Wang technique: A simple and practical steel bar fixation technique in thoracic deformity surgery

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Abstract

Minimally invasive thoracic deformity surgery often requires the use of steel bars. After these bars are placed in the chest wall, they need to be firmly fixed. In the past, most of the fixation techniques needed special fixation plates. Although these methods have certain advantages, their disadvantages are more impressive. We have invented a technique specially used for steel bar fixation. This technique is simple, practical and easy to operate. We used it routinely in all kinds of thoracic deformity operations and achieved satisfactory results. In the past few years, we have carried out thoracic deformity surgeries in more than 300 hospitals in China, and this technique is adopted in all our operation. Because of the obvious advantages, it is unanimously recognized by the peers. It has become a popular technique in chest wall surgery circle. In order to better standardize the naming of this technique, we named it Wang technique. In this paper, the specific contents of this technique are introduced in detail through a case of Wung procedure on pectus excavatum.

Keywords: Wang technique, thoracic deformity, surgery, steel bar, fixation

Introduction

Thoracic deformity is a common disease in chest wall surgery [1-3]. Its incidence is very high and has physiological and psychological harm on the patients, and most patients need surgical treatment [4-7]. The previous operations were open operation. When the concept of minimally invasive surgery entered the clinic, minimally invasive surgery gradually became the mainstream for the treatment of thoracic deformity [4, 5]. At present, the most minimally invasive surgeries in the clinic mainly include Nuss procedure [4, 5], Wang procedure [6, 7], Abramson procedure [8], Wenlin procedure [9] and Wung procedure [10], which are used for the treatment of various deformities. The technical details of these operations are different, but the materials used are basically the same, steel bar materials. During surgery, these materials are placed in the chest wall to complete various plastic operations. In order to make these materials play a better role, they need to be fixed during the operation. The previous fixation methods mostly refer to the fixation methods in Nuss procedure that is, using short fixation plates for fixation [4, 5]. This method has a certain effect, but it also has many disadvantages. In addition to this method, other authors have also designed some fixation methods, but these methods are not practical. Our department was established in 2018 and is the first and the only independent chest wall surgery department in China [1-3]. One of our main tasks is to carry out various types of chest wall deformity surgeries. After years of practice, we have designed a special steel bar fixation method, namely Wang technique. Compared with other fixation methods, this technique has many advantages. It has been used in all our thoracic deformity operations and achieved good results. Additionally, we have performed various thoracic deformity operations in more than 300 hospitals in China. In these operations, we also used this technique. The Chinese counterparts gave high comments on this technique and eventually began to use it. At present, this technique has become the most popular technique in the field of chest wall surgery. This article introduces this technique through a case of Wung procedure of pectus excavatum.

Case Report

The patient, a 15-year-old boy, was admitted to our hospital for surgical treatment because of the depression of the anterior chest wall.

Preoperative examination showed that the anterior chest wall was obviously depressed (Fig 1). Imaging examination showed that the anterior chest wall was depressed and the heart was

obviously compressed (Fig 2). The preoperative diagnosis was pectus excavatum.



Fig 1: Appearance of chest wall before operation. A, Side view; B, Front view.



Fig 2: Chest CT examination. A, The coronal view shows that the lower end of the sternum is deeply depressed, which compresses the heart and pushes the heart to the left thoracic cavity; B, The sagittal view shows the depression below the anterior chest wall. The heart is located between the sternum and thoracic vertebra and is obviously compressed; C, The cross-sectional view shows that the anterior chest wall is depressed and the heart is compressed.

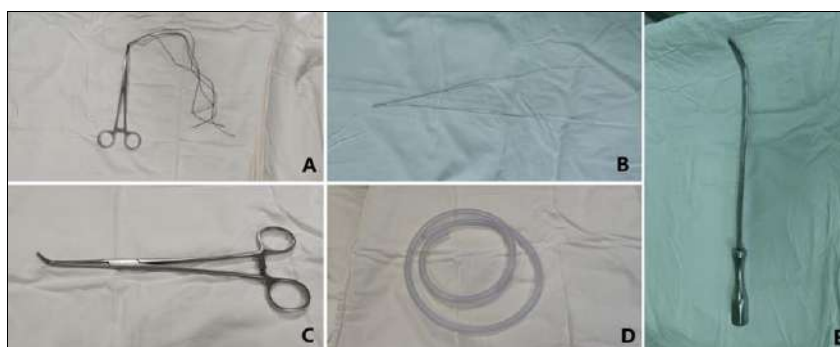


Fig 3: Special preparation before operation. A, Two 10 # silk threads were folded in half, and the middle part of them were clamped with vascular forceps. These silk threads would act as steel wire traction lines; B, The 5 # steel wire was folded in half, which would be prepared as fixation wire; C, Right angle pliers, which would be used for placing steel wire traction lines; D, The suction pipe was cut into several pieces, and each piece was about 50cm in length, which would be used as steel bar guiding tube; E, The introducer, used to place the steel bar guiding tube and finally assist in placing of the steel bar.

Preoperative preparations

Before the operation, some simple preparations need to be made, mainly including the following contents (Fig 3): (1) several 10# silk threads. Two silk threads were folded in half, and the middle of them was clamped with a vascular clamp. These threads will be used as steel wire traction lines; (2) several 5# steel wires (diameter: 0.8mm). They were all folded in half, which will be used for fixation; (3) right angle pliers, for placing steel wire traction lines; (4) the ordinary suction pipe was cut into 2-3 pieces, each about 50cm long, which will be used as steel bar guiding tube; (5) introducer, for placing the steel bar guiding tube.

Operation and Wang technique

The patient's operation was performed under general anesthesia, with supine position and both upper limbs abducted. Longitudinal incisions were made between the axillary midline and frontline on both sides of the chest wall. The incisions were located at the deepest plane of the depression, with a length of 2cm. The subcutaneous tissues and muscle tissues were dissected to expose the nearby ribs. The ribs at the highest point of the depression edge were selected as the fulcrums for the steel bars. An incision between the ribs above the fulcrum was made to enter the thoracic cavity. A right angle pliers was inserted

cross the rib at the fulcrum to make its tip exposed on the opposite side of the rib. The steel wire traction lines were clamped with the tip of the right angle pliers and pulled to the opposite side of the rib, making the traction lines surround the rib. The introducer was inserted into the thoracic cavity through a chest wall incision, passing through the mediastinum to the opposite side of the thoracic cavity, and coming out from the incision on the opposite side of the chest wall. The tip of the introducer was connected to the steel bar guiding tube, and the tube was pulled into the chest cavities and finally pulled out from the contralateral incision. The position of the guiding tube was adjusted so that the steel wire traction lines could surround the rib and the guiding tube at the same time. The second guiding tube was placed in the same way. The operation required two steel bars, which were made into arcs according to the operation requirements. One end of one guiding tube was

connected with one steel bar, and the bar was dragged through the thoracic cavity to make both ends of the bar were located outside the incision of the chest wall on both sides. At this time, the rib and the steel bar were just surrounded by the steel wire traction lines. After the steel bar was turned over, the steel wire was pulled with steel wire traction lines across the rib and the steel bar. The steel wire was tightened and the steel bar was fixed to the fulcrum of the rib. The second steel bar was placed in the same way as the first bar. After the two bars were fixed, drainage tubes were placed in the thoracic cavities, the incisions were closed, and the operation was completed. The operation was smooth, and no complications were found during the operation. The deformity disappeared after the operation, and the thoracic appearance returned to the normal shape (Fig 4, 5, 6, 7).

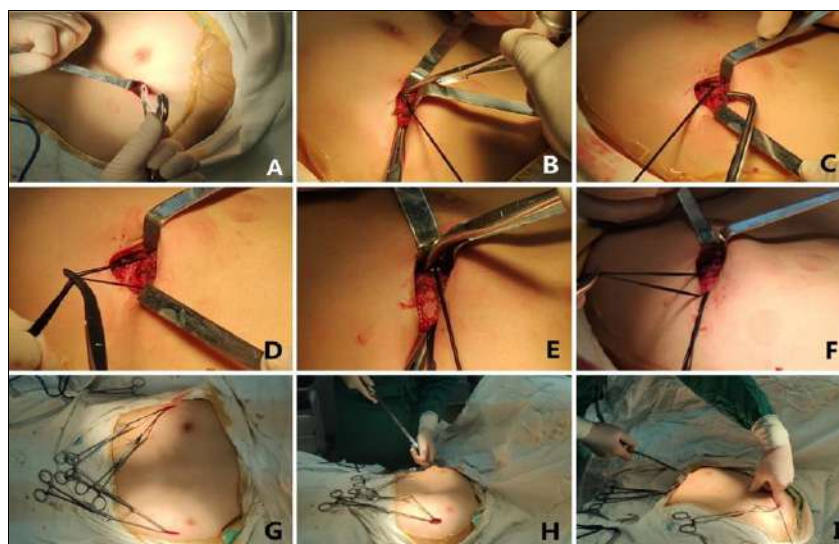


Fig 4: Operation diagram (1). A, The ribs decided as fulcrums for the steel bars were exposed through skin incision; B, The right angle pliers was inserted across the rib to the opposite side of the rib. The middle of the steel wire traction lines was clamped by the right angle pliers; C, The steel wire traction lines were pulled out with the right angle pliers; D, The rib was surrounded by the steel wire traction lines; E, The operation was repeated with right angle pliers and the second steel wire traction lines was placed surrounding the second rib as the fulcrum; F, The second steel wire traction lines was placed; G, The same operations were performed in the chest wall incisions on both sides; H, The introducer was inserted into the thoracic cavity through one incision; I, The introducer was inserted into one thoracic cavity, coming to one side of mediastinum. The finger of another hand was inserted into the contralateral thoracic cavity to meet and guide the introducer, and ensure that the introducer could pass through the mediastinum safely and smoothly.

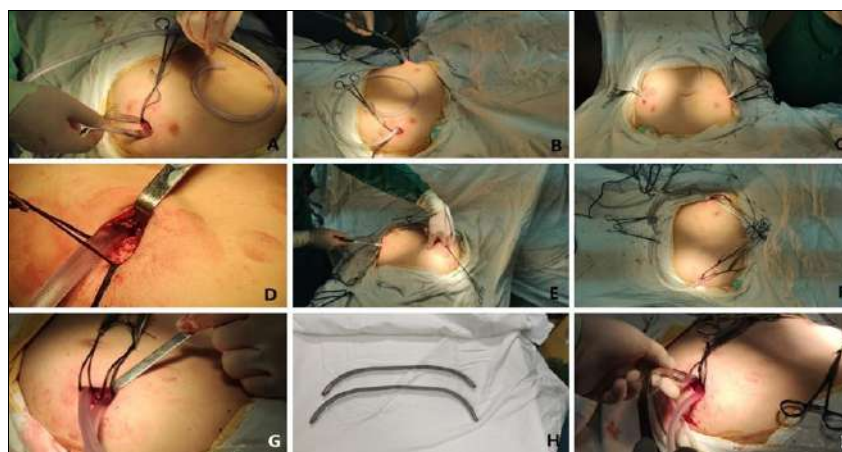


Fig 5: Operation diagram (2). A, The introducer emerged from the incision on opposite side of the chest wall and was connected with the steel bar guiding tube; B, The steel bar guiding tube was pulled into the thoracic cavity; C, After steel bar guiding tube was placed, its two ends were located outside the chest wall incision on both sides, and the middle of it was located in the thoracic cavity; D, The position of the steel wire traction lines were adjusted to surround the rib and the steel bar guiding tube at the same time; E, The second steel bar guiding tube was placed in the same way; F, Two steel bar guiding tubes were placed; G, The position of the two steel wire traction lines were adjusted to surround two different ribs and steel bar guiding tubes respectively; H, The shape of the steel bars were designed according to the need of operation; I, One end of the steel bar was inserted into the steel bar guiding tube.

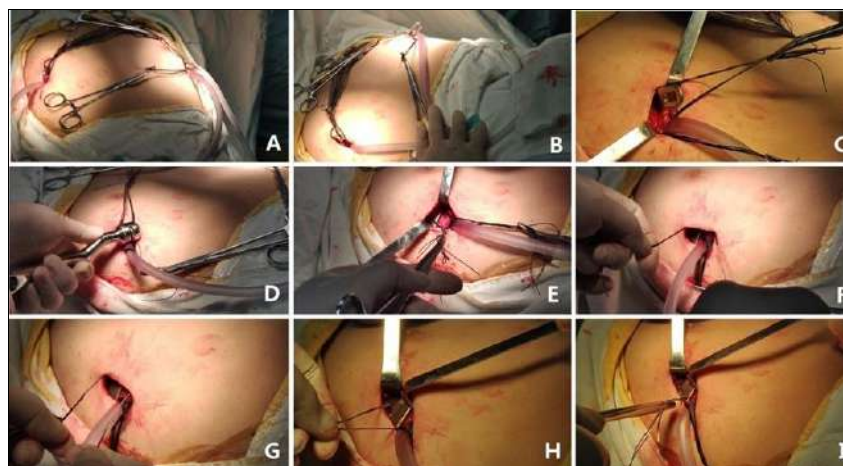


Fig 6: Operation diagram (3). A, The steel bar was pulled into the thoracic cavity and out from the contralateral incision; B, Two ends of the steel bar were located outside the incisions of the chest wall on both sides, and its middle was located in the chest; C, The position of the steel wire traction lines was adjusted to make it surround the rib and the steel bar at the same time; D, The steel bar was turned over; E, Two ends of the bar were placed in the proper position, close to the bony structures of the chest wall, with the depression of the chest wall supported by the bar. The rib and the steel bar were surrounded by the steel wire traction lines; F, Steel wire traction lines were connected with the steel wire; G, The steel wire was pulled into the surgical field to surround the rib and the steel bar; H, After the steel wire was placed, the rib and the steel bar was surrounded by the steel wire simultaneously; I, The steel wire was tightened directly to fix the steel bar at the fulcrum of the rib.

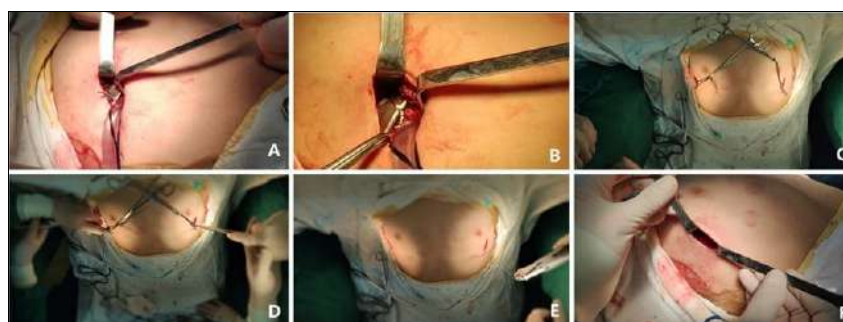


Fig 7: Operation diagram (4). A, The steel wire was cut; B, The end of the steel wire was hidden behind the steel bar; C, The second steel bar was placed in the same way; D, The second steel bar was turned over; E, The second steel bar was fixed with the steel wire; F, Two steel bars were placed and fixed.

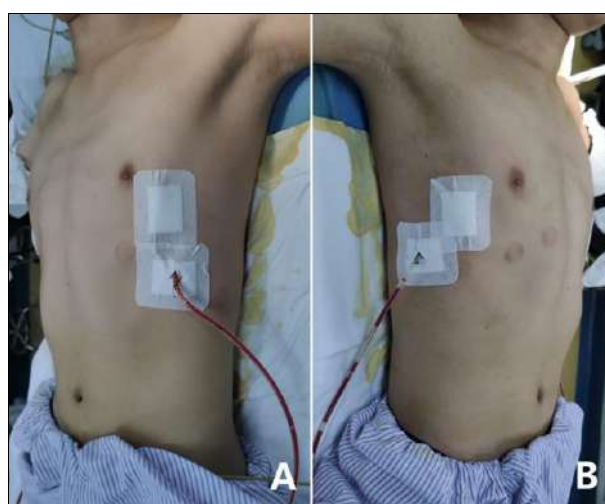


Fig 8: Appearance of chest wall after operation. A, Left view; B, Right view

Discussion

Thoracic deformity is one of the most common chest wall diseases [1-3]. The early operations were all open methods. In terms of the nature of surgery, these operations belong to destructive plastic surgery [2, 3]. In recent years, thoracic deformity surgery has fully entered the era of minimally invasive surgery [4, 5]. One of its main features is to operate with specific materials. Most of these materials are special steel bars.

In order to make the steel bar play a stable role, it must be properly fixed. There were many kinds of methods of fixation in the past, and most of them refer to the fixation method of classic Nuss procedure, that is, using short plates for fixation [4, 5]. Although this method has certain functions, there are a lot of unreasonable defects, so it is necessary to redesign the fixation method [10]. Some authors have made lots of attempts, but the final results are not satisfactory.

Our department is an independent chest wall surgery department, and chest wall deformity surgery is our main work [1-3]. In the long-term clinical practice, we conducted in-depth research on the fixation method of steel bar, and finally designed this new fixation method, namely Wang technique. This technique has the following characteristics: (1) the ribs and steel bars are directly fixed by steel wires, which can make the fixation effect more reliable; (2) The short fixed steel plates are eliminated, which will increase the space in the incision; (3) The steel wire is placed indirectly with the help of the steel wire traction lines, which reduces the difficulty of steel wire placement; (4) Before the steel bar is placed, the steel wire traction lines were placed in advance, which can make the operation more convenient.

Until now, we have applied Wang technique to almost all types of thoracic deformity surgeries, including not only pectus excavatum [6, 7, 10], but also pectus carinatum [9], barrel chest [11, 12], flat chest [13], Poland syndrome, asphyxiating thoracic dystrophy (Jeune syndrome) [14-20], thoracic insufficiency syndrome and other deformities [21-23]. Our experience shows that this method is a simple and practical fixation method. Compared with other methods, Wang technique has obvious advantages.

Conclusion

Wang technique is a simple and practical technique for steel bar fixation. In all kinds of thoracic deformity surgeries, this technique is obviously superior to other fixation methods. It can not only make the operation simpler and safer, but also obtain better fixation effect. Therefore, it is an ideal steel bar fixation technique.

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