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Simple Method to Stabilize a Flail Chest from Trauma

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ABSTRACT

A simple method to stabilize surgically a severe flail chest with pulmonary and cardiac contusions is presented. A flail chest is caused by severe blunt trauma to the chest wall resulting in multiple rib fractures from rib 2 to 3 to 4 ribs up to 10 ribs with associated internal injuries After repairing the internal injuries the surgeon is left with a chest wall that cannot support normal respiration or lung function which leads to pneumonia, empyema, respiratory failure, and multi organ failure.

KEYWORDS

Flail Chest; Chest Trauma; Pulmonary contusion by foreign body

1. INTRODUCTION

A number of elegant and relatively successful techniques using complex and expensive equipment have been promulgated in the literature [1-3] to operatively treat traumatic flail chests with severe lung and heart contusion. In this research paper, I will present a simple yet very effective way to stabilize a traumatic flail chest requiring only an anesthetic machine, a carlens tube (double lumen endotracheal tube) an operating room, and sterile 16-gauge steel wires (Kirschner).

2. MATERIAL AND METHODS

In early 1984, I was on call and was called than Orange Co CA emergency room to see a patient who the E>R> doctors felt was not salvageable. The emergency room doctors desired to stop life support and awaited my verdict. The patient had been removed from her small car with the jaw of life apparatus after a dump truck ran a red light and crushed the left side in. The patient was 18 years old and her left chest had been crushed with ribs sticking out of the skin and air bubbling out with each expiration. 3 chest tubes were place in her left chest and connected to pleur evac suction in the E.R. without re-expansion of the left lung. An endotracheal tube was in good position in her trachea. The chest x-ray showed multiple rib fractures from the second rib to the tenth rib, ribs inside her left lung, and a rib fragment sticking out of her heart. I looked behind the screen shielding her vision from the procedures being done and found her to be alert, oriented and terrified. I told her we would operate on her if she agreed but no guarantee of success could be given. She agreed.

In the operating room the entire left chest was flail from rib 2 to the costal margin with a rib sticking out of the skin and abundant sub-cutaneous emphysema present over the entire chest wall even with maximum suction on the pleural vacuum system. The first maneuver was to

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place a double lumen (Carlens) endotracheal tube in her trachea with light anesthesia. This stabilized her oxygenation and gave an acceptable operating field after she was placed in the right side down left side up position. The chest was entered via 4-5 rib incision. Multiple rib fragments were sticking into both lobes of the left lung upper and lower lobe along with a fragment in the muscle of her left ventricle. Multiple plagited 3-0 non absorbable sutures were placed to encompass the rib where it entered the left ventricle and when this was removed, the sutures were pulled closed and tied; no leakage from the heart was then detected. Where each rib protruded from the lung lobes, a double layer crosswise running suture line was placed (basting stitch) and, using the same suture, a running over and over suture line was run back to the starting point; this was with 3-0 chromic catgut. This caused immediate local inflation and swelling sealing the needle holes. After all of the rib fragments were out of the lung tissue and the holes were over sewn, the left lung could be re- inflated at normal pressures without significant leakage.

The last part of the operation was the most revealing. The week before, I had helped orthopedic friend of mine who could not find a mandated assistant with a bunionectomy and had seen the use and malleability of Kirschner wires (any sterilizable malleable 14 to 16 gauge steel wire). With the bunionectomy set in hand, I drilled, when necessary, and pushed as I molded the wirers through multiple rib marrow cavities; first the anterior alternate ribs and the with the same alternate rib posteriorly (Figure 1). Care was taken to place the appropriate rib fragment in the proper rib. Rib fragments with no blood supply were used to span the space after cleansing with sterile saline. With alternate ribs, only 4 set of Kirschner wire rib beads (strutted ribs) were needed. The wires crossed where they exited the chain of rib beads at the mid axillary line. The ribs fragments between the strutted ribs were then encircled with #2 chromic catgut sutures from the strutted rib above and from the strutted rib below; I made sure that all rib fragments were replaced in their anatomic position. The parietal and visceral surface of the lung was scarified with 4 × 4 sponges. The 3 chest tubes were repositioned and placed on 20 cm H_2O suction and the chest cavity was irrigated with a liter of hot saline with neomycin/kanamycin/bacitracin in it prior to tying the last #2 chromic catgut sutures. This procedure resulted in a chest wall that I could place my upper body weight (~70 pounds) without collapsing and it would move up and down (caudad/cephalad) without problem. The muscle and skin of the chesty wall were closed in multiple layers with 3-0 vicryl in each layer. The Carlens tube was replace with a single lumen endotracheal tube. The patient was returned to ICU.

3. RESULTS

Her postoperative course was benign with all tubes out by 5 days and discharge on the 7th day. She was unhappy with result because when she got back in the competition swimming pool three weeks post-operatively, she could only come within a few seconds of her pre accident times in distance swimming, and could not qualify to compete in the 1984 LA Olympics. One wire had to be removed 6 months later after a hard fall on a curb while roller skating (landed on her left chest). Four years later, she came to see me as she was pregnant and worried that her expanding abdomen might cause problems. A chest x-ray showed wires had not moved and presented no danger to her or fetus; she delivered a normal baby successfully. This patient had a four-year follow-up by the surgeon and the results were verified by him.

4. DISSUSION

The use of Kirschner wires or any malleable sterilizable wire of 12 to 14 gauge in alternate ribs from 3 through 10 with 4 sets of internal wires, collecting all fragments and piecing them together through their marrow cavities, and placing them in their proper anatomic position (takes 10 minutes maximum) gives structural support to the chest wall.

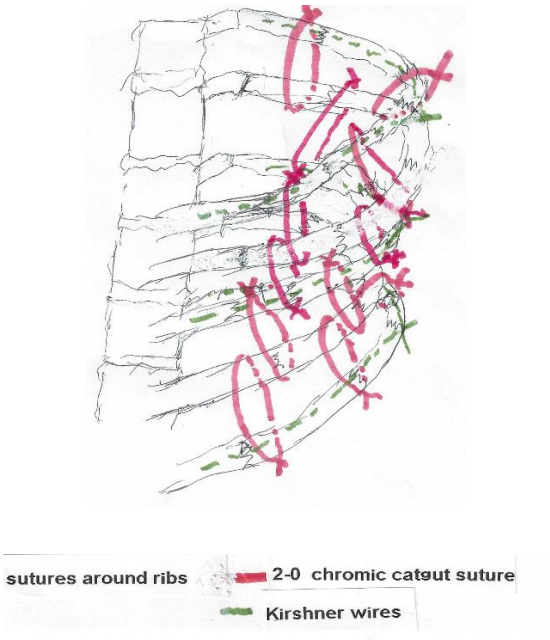

Figure 1: Position of Kirshner wires through marrow cvities and chromic catout.

Using absorbable suture to unite the non-wire-stabilized ribs with the wire stabilized ribs so their fractures heal allows the chest to rapidly regain mobility and flexibility. Using the Kirschner wires as described should stabilize any flail chest as this patient's ribs were all broken off at the spinal column and the sternum/ costal margin. Chromic catgut was used as it will dissolve over 2-4-weeks period further enabling the chest wall to regain its mobility.

5. CONCLUSIONS

One very successful case does not make a given treatment protocol the only one, but it does point to a very essential truth. The chest wall can be stabilized with internal stabilization of fractured ribs by single wires passing through the marrow cavity A multi-center trial is advised for other better surgeons to prove this technique.

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