



Operative Resection of a Chronic Flail Chest Nonunion Revealing Septic Pseudarthrosis: A Case Report

Robin Deville, M.D., Justin Issard, M.D., M.Sc., Anna Vayssette, M.D., Jalal Assouad, M.D., Ph.D.

Department of Thoracic and Vascular Surgery, Hôpital Tenon, Assistance Publique-Hôpitaux de Paris, Paris, France

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Corresponding author

Justin Issard

Tel 33-650555140

Fax 33-140948894

E-mail j.issard@ghspj.fr

ORCID

<https://orcid.org/0000-0001-9051-4088>

We report a case of chest wall resection for painful chest wall nonunion, 5 years after traumatic flail chest and a first attempt at surgical treatment. The decision was made to perform surgery again after 2 years of unsuccessful well-conducted analgesic treatment. During surgery, we found the same sites of pseudarthrosis and decided to perform parietectomy of the fifth, sixth, and seventh ribs. A Gore-Tex patch was used to bridge the gap created by the resection. In immediate postoperative care, the patient's pain was quickly and sufficiently eased by stage 1 and 2 pain killers. The results of bone samples taken from the pseudarthrosis sites all found *Propionibacterium acnes*. Five months after surgery, the patient had considerable improvement in pain sensations. Computed tomography showed healing of ribs, the plate in place, and no sign of complications.

Keywords: Flail chest, Pseudarthrosis, Fracture Fixation, Chest wall resection, Chronic pain, Case report

Case report

Flail chest is diagnosed when at least 3 consecutive ribs are fractured at 2 or more sites creating an incompetent region of the chest wall. Although a large body of literature exists regarding the acute operative and non-operative management of flail chest, limited information is available regarding the management of resultant chronic disability.

We report the case of a 49-year-old man who sustained a left flail chest in a motorcycle versus car accident 5 years ago. He was first treated non-operatively at another institution with level 1 and 3 painkillers combined with thoracic physiotherapy for 4 weeks. The patient sought consultation at our center 2 years post-injury. He described chest pain affecting his quality of life without shortness of breath. He reported severe pain at the time, with a Visual Analog Scale (VAS) score of 7 out of 10. A thoracic scan confirmed pseudarthrosis located on the posterior arches of the fifth, sixth, and seventh left ribs. First-line medical treatment was instituted with stage 1 and 3 painkillers combined with pregabalin for neuropathic pain; however, the patient did not show clinical improvement. The first surgery was performed 3 years after trauma. The proce-

cedure involved neurolysis of the 5th and 6th intercostal nerves without osteosynthesis. After the first surgery, a follow-up was organized with the pain specialist at our institution. However, all the treatments undertaken failed to improve the symptoms and the VAS score remained between 6 and 7 out of 10. The pain specialist and the patient agreed to additional surgery. The patient presented no fever, and a preoperative blood test found no hyperleukocytosis and a C-reactive protein level <5 mg/mL. An *en-bloc* parietectomy, involving the posterior arch of the 5th, 6th, and 7th ribs and intercostal spaces implicated in the symptomatology was performed. Operative site samples were taken for a microbiology examination on a systematic basis. Parietal reinforcement was performed using a 2-mm Gore-Tex patch. During surgery, an epidural catheter and a 24F chest tube were placed to provide postoperative pain management and avoid postoperative pleural effusion. The patient was discharged home on postoperative day 5. He left the hospital with only stage 1 and 2 pain killers and a VAS score for pain of 4 of 10. *Propionibacterium acnes* was found inside all bone samples. Oral antimicrobial therapy was introduced with ofloxacin (400 mg per day) and amoxicillin (6 g per day) for 2 weeks, then only amoxicillin



(6 g per day) for 4 weeks more. No clinical or biological events were reported during the follow-up.

Five months after surgery, the patient reported a decrease of pain, and no clinical or biological signs of sepsis were reported. The pain specialist described a 50% diminution of pain, with a VAS score of 3 out of 10 combined with operation site hypoesthesia. Chronic treatment with duloxetine and pregabalin was pursued. On computed tomography, the ribs appeared to have healed without displacement, and no collection was observed around the material (Figs. 1–3).

The authors declare that the patient's oral consent has been obtained to publish these data.

Discussion

Pain after thoracic trauma usually disappears after 6 to 8 weeks as bone consolidation occurs. However, long-term sequelae of severe chest wall trauma are common. Fabri-

cant et al. [1], in a prospective study of 203 patients, found that 59% of patients had prolonged chest wall pain and 76% had prolonged disability at 2 months post-injury. However, in current practice, most patients with flail chest are not surgically stabilized. Instead, prolonged mechanical ventilation and regional pain control techniques are utilized until the incompetent segment stabilizes by fibrous fusion. The operative stabilization of flail chest is now recognized as a valid approach to improve pulmonary mechanics in selected trauma patients [2]. Yet, the percentage of patients with symptomatic rib nonunion after the conservative management of flail chest is unknown. Surgical treatment of these nonunion sites seems to provide good results [3]. De Jong et al. [3] reported a single-center retrospective study of 19 patients surgically treated for rib fracture nonunion. After a follow-up of 36 months, 61% were satisfied without needing any additional surgery. Nevertheless, persistent pain was a common complaint, and 3 patients needed morphine and 1 patient needed treatment by a pain medicine specialist postoperatively. Contamination of pseudarthrosis sites by *P. acnes*, as observed in our case, is unusual. We did not suspect an infection preoperatively and our intraoperative sampling was performed on a systematic basis. We hypothesize that septic pseudarthrosis occurred spontaneously due to chronic rib malunion. Indeed, *P. acnes* is frequently found in instrumented spine infections, orthopedic fracture nonunion after osteosynthesis, and orthopedic prosthesis loosening. However, these orthopedic procedures are always carried out under rigorous aseptic conditions. Gausden et al. [4] noted that in a series of 18 cases of clavicle osteosynthesis re-operated on for nonunion, 14 of them were positive for *P. acnes*. More recently, Otchwemah et al. [5] retrospectively analyzed bone samples from tibia and femur nonunion after osteosynthesis for fractures, without any clinical or local sign of



Fig. 1. Computed tomography of the sixth rib pseudarthrosis site.

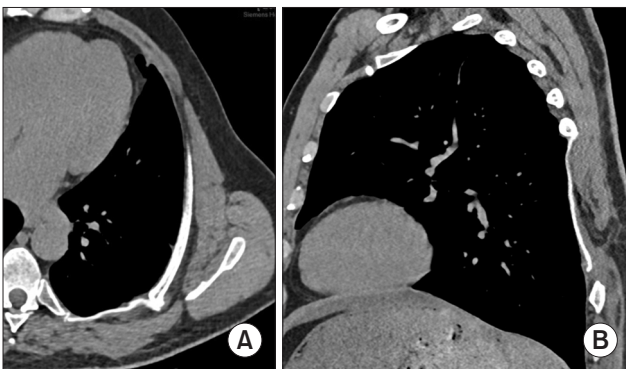


Fig. 2. (A, B) Computed tomography images of chest wall reconstruction 5 months after surgery.

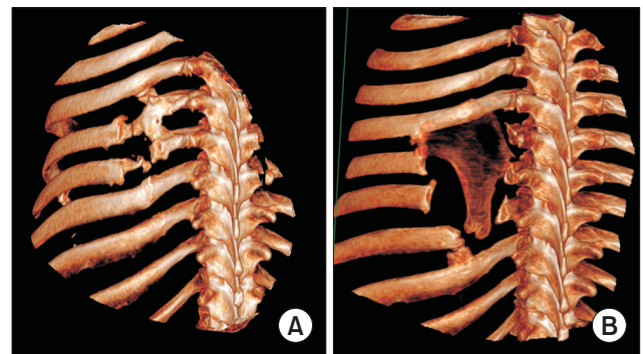


Fig. 3. (A, B) Three-dimensional reconstruction of the pseudarthrosis sites and chest wall reconstruction 5 months after surgery.

infections. Out of 18 patients and at a median of 8.5 months after trauma, microbiological cultures were positive in 8 patients (44%), including 3 patients with *P. acnes*. Unfortunately, no studies of rib fracture nonunion reported microbiological data; thus, it is impossible to evaluate the proportion of septic pseudarthrosis in those cases. The clinical symptoms of *P. acnes* infections are often mild and long-lasting, and previous surgical contamination cannot be excluded in our case.

This case underscores the importance of bacteriologic sampling during surgery for pseudarthrosis. Posttraumatic thoracic pseudarthrosis is a common cause of chronic chest pain after trauma. Radical surgical treatment such as parietectomy can yield good results, and a septic etiology should be considered in every case.

Article information

ORCID

Robin Deville: <https://orcid.org/0009-0000-7896-9573>

Justin Issard: <https://orcid.org/0000-0001-9051-4088>

Anna Vayssette: <https://orcid.org/0009-0009-1701-455X>

Jalal Assouad: <https://orcid.org/0000-0003-1409-3351>

Author contributions

Robin Deville collected the data and drafted this work. Justin Issard, Anna Vayssette, and Jalal Assouad contributed equally to the proofreading. Final approval of the manuscript: all authors.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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References

1. Fabricant L, Ham B, Mullins R, Mayberry J. Prolonged pain and disability are common after rib fractures. *Am J Surg* 2013;205:511-6. <https://doi.org/10.1016/j.amjsurg.2012.12.007>
2. Liu X, Xiong K. Surgical management versus non-surgical management of rib fractures in chest trauma: a systematic review and meta-analysis. *J Cardiothorac Surg* 2019;14:45. <https://doi.org/10.1186/s13019-019-0865-3>
3. de Jong MB, Houwert RM, van Heerde S, de Steenwinkel M, Hietbrink F, Leenen LP. Surgical treatment of rib fracture nonunion: a single center experience. *Injury* 2018;49:599-603. <https://doi.org/10.1016/j.injury.2018.01.004>
4. Gausden EB, Villa J, Warner SJ, et al. Nonunion after clavicle osteosynthesis: high incidence of *Propionibacterium acnes*. *J Orthop Trauma* 2017;31:229-35. <https://doi.org/10.1097/BOT.0000000000000770>
5. Otchwemah R, Moczko T, Marche B, Mattner F, Probst C, Tjardes T. High prevalence of bacteria in clinically aseptic non-unions of the tibia and the femur in tissue biopsies. *Eur J Trauma Emerg Surg* 2020;46:1093-7. <https://doi.org/10.1007/s00068-018-1010-z>