Clinical Case Report

Medicine®

OPEN

Acquired scoliosis following Nuss procedure for pectus excavatum

A case report

Yichen Meng, MD, Tao Lin, MD, Wei Shao, MD, Rui Gao, MD, Xuhui Zhou, MD*

Abstract

Rationale: Nuss procedure is a safe and popular minimally invasive surgical technique for the correction of pectus excavatum in adolescents. Acquired scoliosis over 50 degrees after Nuss procedure has never been reported.

Patient concerns: A 14-year-old boy was referred to pediatric surgery for pectus excavatum deformity. He underwent a successful Nuss procedure. At follow up, the patient was noted having an asymmetric back whole spine X-ray showed a right-sided thoracic curve with a Cobb angle of 54 degrees.

Interventions and outcomes: We obtained a satisfactory result by removing the pectus bar and prescribing the patient a brace.

Lessons: This report demonstrates that the spine should be evaluated routinely before and after Nuss procedure. Besides, spinal fusion is not recommended for acquired scoliosis following pectus excavatum surgery.

Abbreviation: CT = Computed tomography.

Keywords: nuss procedure, pectus excavatum, scoliosis

1. Introduction

Pectus excavatum, characterized by a depression of the sternum in the anterior chest wall, may cause cardiorespiratory dysfunction, chest pain, psychosocial problems and other diseases.[1,2] Patients with a Haller index over 3.25 generally require surgical correction. Nuss procedure is a safe and popular minimally invasive surgical technique for the correction of pectus excavatum in adolescents. The most common complications of this procedure include bar-related adverse events and pneumothorax.[3] Acquired scoliosis following Nuss procedure is quite rare and only 2 cases have been reported in the literature.[4] However, both cases were of mild curve with a Cobb angle less than 20 degrees. Here, we present a 14-year-old male who presented with an acquired curve over 50 degrees after pectus excavatum surgery. This patient was treated with removal of the pectus bar and wearing a brace. The scoliosis has improved greatly at the last follow-up. Informed written consent was obtained from the patient for publication of this case report and accompanying images.

2. Case report

A 14-year-old boy was referred to pediatric surgery for pectus excavatum deformity. The depression of chest wall had been noticed when he was 10 and progressed in the past years. He complained of unsatisfied appearance and occasional shortness of breath upon exertion, but no chest pain or palpitations. On physical examination, a sunken sternum was noted. Computed tomography (CT) scan of the chest revealed a Haller index measuring 3.26, which supported the diagnosis of a pectus deformity. PA chest radiograph revealed no evidence of scoliosis of the spine (Fig. 1A). Pulmonary function tests were within normal limits. The patient underwent a Nuss procedure (Fig. 1B). After general anesthesia, 2 small incisions were made bilaterally at the mid-axillary line of the chest. Then an introducer was pushed through the skin incision to create a substernal tunnel. A bent metal bar was slipped under the sternum under the guidance of a thoracoscope. Once placed in an appropriate position, the bar was flipped 180 degrees and elevated the depression as expected. Stabilizers and wires were used to fix the bar to the ribs. The surgery was completed successfully and the recovery process was uneventful. Four weeks postoperatively, the patient was noted to have an asymmetric back and referred to an orthopedic surgeon. Whole spine X-ray showed a right-sided thoracic curve ranging from T3 to L4 with a Cobb angle of 54 degrees (Figs. 1C and 2A). Scoliosis correction was strongly recommended but declined. Alternatively, we removed the pectus bar in case of curve progression. Chest CT revealed a Haller index measuring 3.02 postoperatively. Full spine radiograph demonstrated that the curve magnitude decreased from 54 to 41 degrees

Editor: N/A.

The authors declare no conflict of interest.

Department of Orthopedics, Shanghai Changzheng Hospital, Second Military Medical University, No. 415 Fengyang Road, Shanghai, People's Republic of China.

** Correspondence: Xuhui Zhou, Changzheng Hospital, Shanghai, People's Republic of China (e-mail: zhouxuhui@smmu.edu.cn).*

Medicine (2019) 98:1(e13855)

Received: 13 September 2018 / Received in final form: 30 November 2018 / Accepted: 5 December 2018

http://dx.doi.org/10.1097/MD.0000000000013855

Figure 1. (A) Chest radiograph before the Nuss procedure. (B) Immediate postoperative chest radiograph. (C) Whole spine radiograph revealed a thoracic curve at four weeks' follow-up postoperatively. (D) Whole spine radiograph taken after pectus bar removal. (E) Whole spine radiograph taken in a brace. (F) Whole spine radiograph taken at the last follow-up.

(Fig. 1D). Moreover, we prescribed the patient to wear a customized Boston-type orthosis for 12 h per day (Figs. 1E and 2B). Three months later, the curve disappeared (Figs. 1F and 2C).

3. Discussion

Nuss procedure was first described as a minimally invasive technique for pectus excavatum correction by Nuss et al in the 1980s.[5] Over the past years, several modifications have been developed improving the efficacy and safety of Nuss procedure.[6–8]

Figure 2. (A) Photograph showed asymmetry of the back. (B) Appearance in a brace. (C) Photograph taken at the last follow-up.

Comparing with open techniques, such as Ravitch and Sauerbruch, Nuss procedure have several advantages including avoidance of osteotomies, less bleeding, shorter hospital stay, good cosmetic results and fewer complications.[3,9] The frequent association between pectus excavatum and scoliosis has been reported in the literature. However, acquired scoliosis following Nuss procedure have been rarely reported.[10–12] One possible explanation for the cause of acquired scoliosis following Nuss procedure was that the Nuss procedure forcibly changes the anatomical environment of the thorax by insertion of metal bars. Due to the integrality of the anterior and posterior thorax, the Nuss procedure corrects the depression of anterior thorax, but also develops considerable stresses on the spine, which may cause development of scoliosis.[13] Scoliosis is defined as a lateral curvature of the spine with a Cobb angle of more than 10 degrees. Management of scoliosis is mainly determined by the Cobb angle of curves and skeletal maturity. Mild curves (less than 30 degrees) may need observation and exercise. Curves between 30 and 50 degrees usually need bracing. Curves larger than 50 degrees are associated with a high risk of progression and usually indicate the need for surgery.[14]

Up to now, only 2 cases of acquired scoliosis following Nuss procedure have been reported. Both cases were of mild scoliosis (14 degrees and 16 degrees, respectively) and exercise achieved satisfactory results.[4] In our case, the patient presented with an acquired curve over 50 degrees which requiring surgical correction. However, the patient's guardians refused to have a surgery. Therefore, we attempted to remove the pectus bar and recommended the patient to wear a brace. At the last follow-up, the scoliosis has been disappeared. Niedbala et al suggested that acquired scoliosis resulted from acute asymmetric pressures following the Nuss repair.[4] This hypothesis was confirmed by the fact that the scoliosis improved immediately after the bar removal in our case. In addition, as acquired scoliosis following Nuss repair is typically functional but not structural, spinal fusion surgery was not necessarily recommended even the curve was of over 50 degrees. Shu et al analyzed the complications of 406 patients undergoing Nuss operation and found 2 patients had post-operative scoliosis because of severe pain.[15] In our case, the patient did not complain of post-operative pain, which suggested pain was not the cause of acquired scoliosis in this case.

The spine should be routinely evaluated before and after surgical repair of pectus excavatum. For acquired scoliosis following the Nuss procedure, conservative treatment including physical therapy and bracing could achieve an excellent outcome.

Author contributions

Conceptualization: Xuhui Zhou.
Data curation: Tao Lin, Wei Shao, Xuhui Zhou.
Formal analysis: Wei Shao.
Investigation: Tao Lin, Rui Gao.
Methodology: Rui Gao.
Writing – original draft: Yichen Meng, Tao Lin, Xuhui Zhou.
Writing – review & editing: Xuhui Zhou.
Xuhui Zhou orcid: 0000-0002-8026-5468.

References

[1] Park HJ, Jeong JY, Jo WM, et al. Minimally invasive repair of pectus excavatum: a novel morphology-tailored, patient-specific approach. J Thorac Cardiovasc Surg 2010;139:379–86.
[2] Felts E, Jouve JL, Blondel B, et al. Child pectus excavatum: correction by minimally invasive surgery. Orthop Traumatol Surg Res 2009;95: 190–5.
[3] Protopapas AD, Athanasiou T. Peri-operative data on the Nuss procedure in children with pectus excavatum: independent survey of the first 20 years' data. J Cardiothorac Surg 2008;3:40.
[4] Niedbala A, Adams M, Boswell WC, et al. Acquired thoracic scoliosis following minimally invasive repair of pectus excavatum. Am Surg 2003;69:530–3.
[5] Nuss D, Kelly REJr, Croitoru DP, et al. A 10-year review of a minimally invasive technique for the correction of pectus excavatum. J Pediatr Surg 1998;33:545–52.
[6] Croitoru DP, Kelly REJr, Goretsky MJ, et al. Experience and modification update for the minimally invasive Nuss technique for pectus excavatum repair in 303 patients. J Pediatr Surg 2002;37:437–45.
[7] Hebra A, Gauderer MW, Tagge EP, et al. A simple technique for preventing bar displacement with the Nuss repair of pectus excavatum. J Pediatr Surg 2001;36:1266–8.
[8] Wu PC, Knauer EM, McGowan GE, et al. Repair of pectus excavatum deformities in children: a new perspective of treatment using minimal access surgical technique. Arch Surg 2001;136:419–24.
[9] Nuss D. Recent experiences with minimally invasive pectus excavatum repair "Nuss procedure". Jpn J Thorac Cardiovasc Surg 2005;53: 338–44.
[10] Hong JY, Suh SW, Park HJ, et al. Correlations of adolescent idiopathic scoliosis and pectus excavatum. J Pediatr Orthop 2011;31:870–4.
[11] Wang Y, Chen G, Xie L, et al. Mechanical factors play an important role in pectus excavatum with thoracic scoliosis. J Cardiothorac Surg 2012;7:118.
[12] Park HJ, Lee SY, Lee CS, et al. The Nuss procedure for pectus excavatum: evolution of techniques and early results on 322 patients. Ann Thorac Surg 2004;77:289–95.
[13] Nagasao T, Noguchi M, Miyamoto J, et al. Dynamic effects of the Nuss procedure on the spine in asymmetric pectus excavatum. J Thorac Cardiovasc Surg 2010;140:1294–9. e1291.
[14] Weinstein SL, Ponseti IV. Curve progression in idiopathic scoliosis. J Bone Joint Surg Am 1983;65:447–55.
[15] Shu Q, Shi Z, Xu WZ, et al. Experience in minimally invasive Nuss operation for 406 children with pectus excavatum. World J Pediatr 2011;7:257–61.