Journal of Pediatric Surgery 53 (2018) 733–739

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Pain and sensory disturbances following surgical repair of pectus carinatum

Marie Veje Knudsen [a,b,*], Hans K. Pilegaard [b,c], Kasper Grosen [b,d,e]

[a] Department of Physiotherapy and Occupational Therapy, Aarhus University Hospital, Palle Juul-Jensens Boulevard 99, 8200 Aarhus N, Denmark
[b] Department of Cardiothoracic and Vascular Surgery, Aarhus University Hospital, Palle Juul-Jensens Boulevard 99, 8200 Aarhus N, Denmark
[c] Department of Clinical Medicine, Aarhus University, Denmark
[d] Mech-Sense, Department of Gastroenterology & Hepatology, Aalborg University Hospital, Aalborg, Denmark
[e] Danish Pain Research Centre, Department of Clinical Medicine, Aarhus University, Nørrebrogade 44, 8000 Aarhus C, Denmark

ARTICLE INFO

Article history:
Received 28 February 2017
Received in revised form 26 July 2017
Accepted 11 August 2017

Key words:
Pectus carinatum
Pain
Postoperative
Sensory disturbance

ABSTRACT

Background/Purpose: The purpose of this study was to assess the characteristics of persistent postoperative pain and sensory disturbances following surgical repair of pectus carinatum.
Methods: Using a prospective observational design, 28 patients were assessed before, 6 weeks and 6 months after a modified Ravitch operation for pectus carinatum. Postoperative pain was assessed using the Short Form McGill Pain Questionnaire. Sensory testing was conducted to detect brush-evoked allodynia and pinprick hyperalgesia. Additionally, generic and disease-specific quality of life was assessed using the Short Form-36 Health Survey and the Nuss Questionnaire Modified for Adults before and after surgery.
Results: Six weeks after surgery, ten patients reported mild pain or discomfort. Six months after surgery, four patients reported only mild pain. Allodynia was detected in two patients 6 weeks and 6 months after surgery. Hyperalgesia was detected in eight patients 6 weeks after surgery, and in six patients 6 months after surgery. Generic quality of life was significantly improved over time.
Conclusions: The study showed no significant pain problems, a tendency to reduced sensory disturbances and significant improvements in quality of life 6 months after surgical repair of pectus carinatum. Future studies should include a longer follow-up period to determine if these positive results are persistent.
Levels of evidence: 1 (Prognosis Study).

Surgical repair of pectus carinatum (PC) is typically not medically indicated but performed in healthy adolescents to avoid cosmetic and psychological discomfort [1,2]. We have previously reported that surgical repair of PC generally improved body image, mental health and self-esteem [3]. However, patients undergoing pectus repair may also experience moderate to severe acute postoperative pain and the procedure may cause long-term discomfort and even persistent post-surgical pain [2]. Chronic pain after surgery continues to be a clinical challenge and knowledge regarding the mechanisms underlying this development remains limited [4]. Moreover, there is an association between the degree of acute postoperative pain and the subsequent development of chronic pain after several surgical procedures, which highlights the importance of sufficient perioperative pain control [4]. Chronic postoperative pain is caused by intraoperative nerve damage, which can lead to sensory disturbances in the surgical field [5,6]. Both persistent postoperative pain and sensory disturbances may have a negative impact on daily activities, satisfaction, and quality of life after surgery [5,6]. Thus, the risk of long-term disability is a major concern in cosmetic surgery. To explore current knowledge about pain and sensory disturbances in PC patients, a comprehensive literature search was performed in the PubMed database using the terms "postoperative pain/pain, postoperative [MeSH]", "sensory disturbances", and "pectus carinatum/Pectus Carinatum/surgery* [MeSH]" in combination. A study by Kuru et al. was identified, but duration of pain and analgesics were only reported as part of assessing postoperative patient satisfaction [7]. Thus, the literature search did not reveal any relevant papers reporting postoperative pain and sensory disturbances in detail after PC repair.

1. Objective

The objective of the study was to assess short and long-term effects of surgical intervention related to development of persistent postoperative pain and sensory disturbances after surgical repair of PC.

* Corresponding author. Tel.: +45 78 45 67 35; fax: +45 78 45 67 04.
E-mail addresses: mariknud@rm.dk (M.V. Knudsen), pilegaard@dadlnet.dk (H.K. Pilegaard), kasper.grosen@clin.au.dk (K. Grosen).

http://dx.doi.org/10.1016/j.jpedsurg.2017.08.015
0022-3468/

2. Material and methods

The overall study design was a prospective observational single-centre cohort study. Results on health-related quality of life, body image and self-esteem have been reported previously [3]. Based on the same study sample, the present study was designed to assess persistent postoperative pain and sensory disturbances following surgical PC repair. Briefly, the study consisted of a preoperative and a postoperative session with 6 weeks in between. At these two sessions, pain was evaluated by a self-reported questionnaire, and the principal investigator (MVK) conducted bedside dynamic quantitative sensory testing. Six months after surgery, patients repeated the self-reported pain questionnaire and performed sensory testing themselves at home based on detailed instructions.

2.1. Ethics statement

Patients received written information about the study before hospitalization along with the appointment for surgery. Upon arrival at the department, the principal investigator repeated the study purpose to eligible patients before participating in the standard preoperative programme. Written informed consent was obtained from patients ≥18 years, and written consent was obtained in association with the parents to patients aged 15–17 years. The study was approved by the Danish Data Protection Agency (File no. 2012–41-0397) and registered in the ClinicalTrials.gov database (ClinicalTrials.gov Identifier: NCT01692392). According to Danish law, approval was not required from The Central Denmark Region Committees on Health Research Ethics. Patients and authors did not have any financial interests in the study.

2.2. Setting and patients

Consecutive patients undergoing surgical PC repair were prospectively recruited at the Department of Cardiothoracic and Vascular Surgery, Aarhus University Hospital in Denmark. The study data was collected as part of a master thesis. These circumstances dictated that all patients were recruited over a one-year period (May 2012 to May 2013). Inability to speak and understand Danish was the only exclusion criteria.

2.3. Study overview

A schematic illustration of the study protocol is shown in Fig. 1. Patients participated in one quantitative sensory testing session before surgery and two sessions after surgery (6 weeks and 6 months after surgery). Preoperatively, patients were informed about the purpose of the study and underwent a training session to familiarize the patients with the different stimuli modalities and how to rate these stimuli. Quantitative sensory testing consisted of assessments of light-stroking perception and pinprick stimulation in the area surrounding the surgical incision as described by Stubhaug et al. [8]. This procedure is not associated with pain in individuals with normal sensory function. Of note, preoperative sensory testing was carried out from the periphery and towards the planned surgical incision in the midline along horizontal lines. A numerical rating scale (NRS), ranging from 0 (no pain) to 10 (worst pain imaginable) was used to evaluate the perceived stimulation intensity. Additionally, patients were asked to describe the intensity and quality of postoperative pain using the Short Form McGill Pain Questionnaire (SF-MPQ). At 6 months post-surgically, the SF-MPQ, a supplemental questionnaire on sensory disturbances and detailed instructions on how to perform the sensory testing using an enclosed cotton bud, were forwarded by mail together with a prepaid return envelope. In case of no response, a first reminder was forwarded after two weeks by e-mail followed by a phone call. Contact to patients about missing questionnaires was attempted up to three times. The study was closed on 1 November 2013 after the last patient's last follow-up contact.

2.4. Surgical procedure

The surgical procedure was performed by two highly experienced thoracic surgeons within the field (Surgeon 1 had performed more than 1800 NUSS procedures and 250 Ravitch procedures, and surgeon 2 had performed more than 40 Ravitch procedures). All patients underwent a standardized regime with the modified Ravitch procedure for PC repair. The surgical technique has previously been described in detail [9]. In brief, the surgical repair was performed through a midline incision. Musculi pectoralis majores were raised to allow resection of the cartilages including the medial part of the ribs if necessary. The perichondrium was saved and the sheaths shortened with sutures. In case of persisting prominence of the sternum, an asymmetric deformity or rotation of the sternum an osteotomy was made to correct the sternum in a suitable position [9].

2.5. Postoperative pain management

All patients received standardized perioperative analgesia. Two hours before scheduled surgery, oral diazepam (2.5–5 mg) and acetaminophen (2000 mg) were administered as premedication. The first 24 h post-surgery, pain management consisted of morphine administered through an Intravenous Patient Controlled Analgesia Pump. Simultaneously, a standard oral pain management regime was initiated from the day of surgery until 14 days post-surgery consisting of acetaminophen 2000 mg/day and ibuprofen 1200 mg/day. Analgesic use beyond day 14 was not accounted for.

2.6. Outcomes

2.6.1. Postoperative pain features

Pain was defined according to responses to the SF-MPQ [10]. We used the SF-MPQ to evaluate: 1) pain prior to the surgery, 2) late postoperative pain 6 weeks after surgery, and 3) persistent postoperative

	At hospital		At home
	A	**B**	**C**
SF-MPQ	✔	✔	✔
QST	✔	✔	
S-QST			✔

Fig. 1. The study illustrated schematically SF-MPQ: Short Form McGill Pain Questionnaire, QST: Quantitative sensory testing, S-QST: Self-assessed sensory testing. **A:** The day before scheduled surgery, patients filled in the SF-MPQ and underwent QST; **B:** Six weeks following surgery, the patients filled in the SF-MPQ and underwent QST; **C:** Six month following surgery, patients filled in the SF-MPQ and performed S-QST based on a supplemental instructional questionnaire.