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Spinal deformity after thoracotomy in children with pulmonary hydatid disease

Şehmuz Kaya[1*], Abdulmutalip Karaaslanlı[2] and Burhan Beger[3]

Abstract

Background Pulmonary hydatid cyst disease is a common zoonotic infection, especially in agricultural and livestock communities. Thoracotomy is an important surgical procedure in the treatment of pulmonary hydatid cysts in children. However, the development of a spinal deformity is one of the long-term musculoskeletal complications of this procedure. The aim of this study was to evaluate the incidence, risk factors and clinical outcomes of spinal deformity in pediatric patients after thoracotomy.

Methods Between 2008 and 2022, 116 pediatric patients who underwent thoracotomy for pulmonary hydatid disease and met the study criteria were retrospectively reviewed. Age, sex, side of surgery, pre- and postoperative spinal radiographs, presence of spinal deformity and Cobb angles were measured.

Results Spinal deformities developed in 57.8% of 116 patients after thoracotomy. The risk of spinal deformity increases with decreasing age at surgery. The side of the thoracotomy can influence the direction of the apex of the spinal deformity. However, sex had no significant effect on the development of spinal deformity.

Conclusions Children with pulmonary hydatid cyst disease are at high risk of developing spinal deformity after thoracotomy, and this risk is greater in younger patients. This study emphasises the importance of multidisciplinary approaches in the prevention and management of spinal deformity.

Keywords Scoliosis, Thoracotomy, Hydatid cyst, Spinal deformity

Background

Hydatid cyst disease is a common zoonotic infection caused by Echinococcus granulosus and is especially prevalent in agricultural and animal husbandry communities worldwide [1]. Pulmonary involvement is common in children with complications such as rupture, secondary infection, and bronchial compression [2–4]. Pulmonary hydatid cysts tend to grow faster than liver cysts because of their elastic tissue structure, which may lead to severe respiratory symptoms [5].

Thoracotomy is the primary surgical intervention for the treatment of pulmonary hydatid cysts, with documented success in the majority of cases. However, long-term musculoskeletal complications, including spinal deformity, pose a significant problem [6, 7]. The literature has reported that the incidence rates of spinal deformity in pediatric patients following thoracotomy range from 6 to 50%, with the development of this deformity being associated with surgical trauma, rib resection and muscle dissection [8, 9]. The mechanisms and risk factors that contribute to the development of spinal deformity,

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particularly in pediatric patients, have not been thoroughly investigated. However, the potential roles of postoperative spinal stability, disruption of rib integrity and pectoral muscle damage during thoracotomy in the development of these deformities have been postulated [10–12]. The present study aimed to evaluate the prevalence, risk factors and clinical outcomes of spinal deformity in children undergoing thoracotomy for pulmonary hydatid disease. The importance of multidisciplinary approaches in addressing the literature gaps has been emphasised [13, 14].

Materials and methods

This study was approved by Yüzüncü Yıl University Non-Interventional Clinical Research Ethics Committee (approval number: 2024/11–28). Owing to the retrospective nature of the study and the anonymized data analysis, informed consent was not obtained from participants with the approval of the ethics committee. We retrospectively analysed 165 patients aged < 18 years who underwent thoracotomy cyst excision for pulmonary hydatid disease between 2008 and 2022. The present study exclusively included patients who were subjected to a minimum of 24 months of postoperative observation. This approach was adopted to eliminate the influence of pain-related scoliosis and to ensure the attainment of more precise results. Patients who did not attend follow-up, whose records could not be accessed, who underwent additional thoracic surgery for another reason, who had vertebral abnormalities on preoperative radiographs, and whose follow-up radiographs were inadequate were excluded from the study. A total of 116 patients who met the study criteria were included in the study (Fig. 1).

Sex, age, age at surgery, side of surgery, presence of spinal deformity on preoperative spinal radiographs, presence of spinal deformity on postoperative spinal radiographs, dates of control examinations, apex side if a spinal deformity was present, and the Cobb angle were measured and recorded (Fig. 2). The Cobb angle measurements were performed independently by an experienced orthopedist and a neurosurgeon and then averaged. The Scoliosis Research Society defines scoliosis as a deformity of the spine, characterised by a Cobb angle of at least 10 degrees [15]. According to this definition, a deformity of more than 10 degrees was considered to be scoliosis.

Surgical procedure

Patients were administered albendazole tablets at a dose of 10 mg/kg for a period of one week prior to surgery, and this treatment was continued for a period of three months postoperatively. In addition, 100 mg/kg cefazolin was administered intravenously 30 min prior to surgery for the purpose of antibiotic prophylaxis.

The surgical procedure was performed under general anaesthesia. Patients were placed in the lateral decubitus position under sterile conditions and positioned with the surgical side up. Following sterile staining and draping of the surgical field, the standard posterolateral thoracotomy incision site was determined, and the skin and subcutaneous tissues were cut with a scalpel. The intercostal muscles were then carefully separated, and the costal space was expanded with an intercostal retractor. The surgical field was then accessed, and cystotomy, fistula closure and capitonage procedures were performed, followed by the placement of a chest tube. As the surgical field was closed, the intercostal muscles, subcutaneous tissue and skin were sutured in accordance with the anatomical layers. During the postoperative period, the patient's need for analgesia was met, and early mobilisation was encouraged.

For patients with bilateral pulmonary hydatid disease, the same procedure was performed for the other side approximately one month after the initial surgery.

Statistical analysis

The continuous variables in the study were analysed via descriptive statistics, which included the mean, standard deviation, and values. Categorical variables are expressed as numbers and percentages. Independent tests (ANOVAs) were employed to compare group averages in terms of continuous variables, while Pearson correlation coefficients were calculated to ascertain the relationships between variables. The relationships between categorical variables were determined via the chi-square test. The statistical significance level was set at 5%, and the IBM SPSS for Windows, version 26, statistical package program was utilised for the calculations.

Results

The present study comprehensively examined a cohort of 116 patients, ranging in age from 0 to 18 years, who underwent thoracotomy for the treatment of pulmonary hydatid disease. The demographic distribution of the patient population revealed a preponderance of males, with 65 patients (56%), and a female demographic of 51 patients (44%). The mean age of the patients at the time of surgery was 7.6 years. A detailed analysis of the patient population revealed that 49 patients did not exhibit spinal deformity, whereas 67 patients demonstrated the presence of spinal deformity, as evidenced by control radiographs. The mean follow-up period of the patients was 52 months (24–164 months) (Table 1).

In the present study, the relationship between sex and the development of spinal deformity was investigated. The analysis revealed no statistically significant relationship between these two variables ($p = 0.180$). These findings indicate that the development of spinal deformity

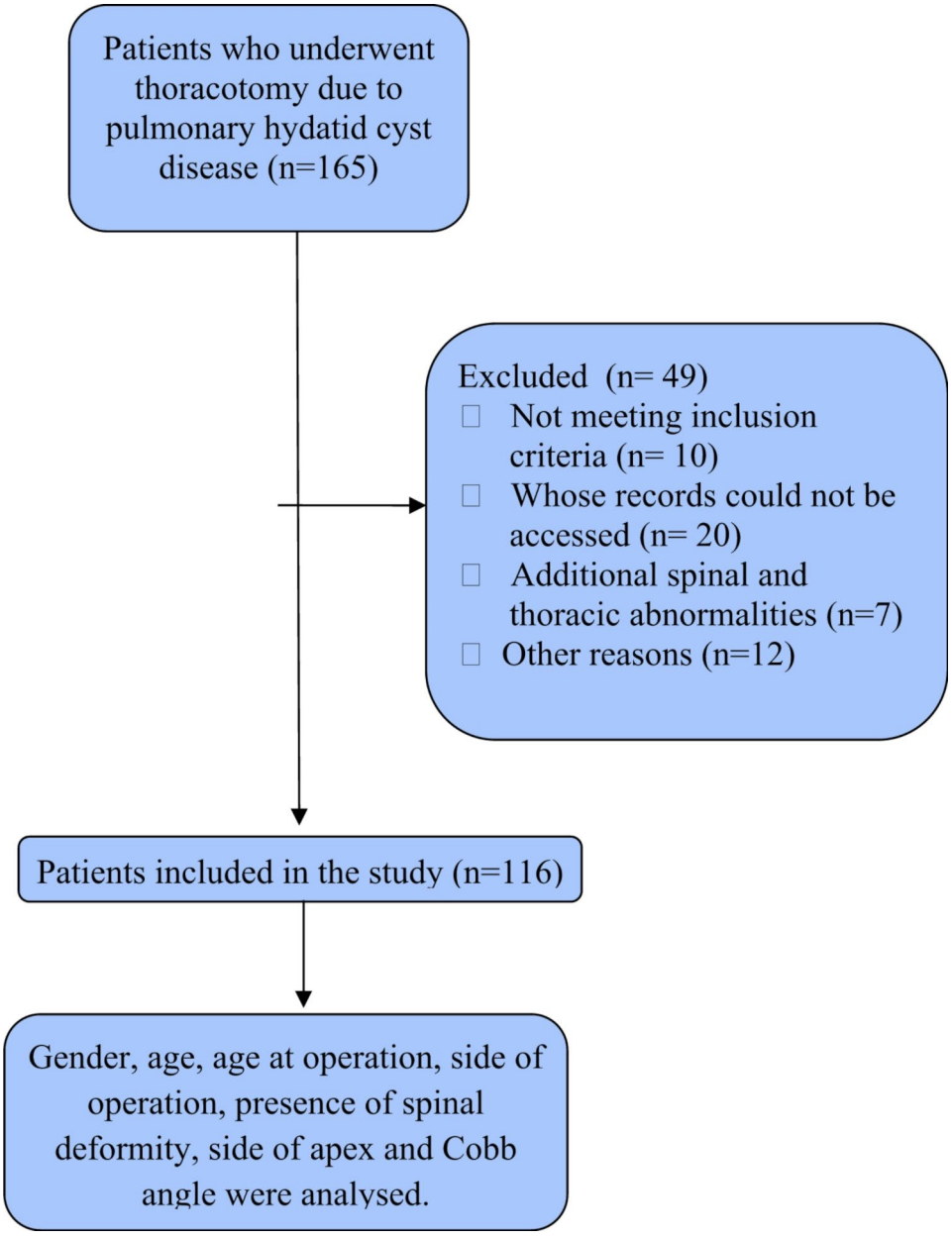

Fig. 1 Flow diagram

is not contingent on sex. Furthermore, the investigation revealed no statistically significant relationship between the Cobb angle and sex in patients with existing spinal deformities ($p = 0.235$).

The investigation revealed that the side of the thoracotomy had no statistically significant influence on the development of the spinal deformity ($p = 0.672$). These findings suggest that the development of a spinal deformity is not associated with the side of the cyst. A significant and negative correlation was identified between decreasing age at thoracotomy and the development of spinal deformity ($p = 0.001$). This finding indicates that patients who underwent the procedure at younger ages were more susceptible to developing spinal deformity. A negative correlation of 10.9% was observed between thoracotomy age and the Cobb angle; however, this correlation was not statistically significant ($p = 0.381$). In our study, the total number of patients with a Cobb angle of 10 degrees or more who were diagnosed with scoliosis was 5, and all of these patients were children under the age of 8. These findings suggest that the Cobb angle may increase more in patients who undergo thoracotomy at younger ages (Fig. 3).

The statistical analysis performed to evaluate the relationship between the thoracotomy side and the side of the apex of the spinal deformity revealed a statistically

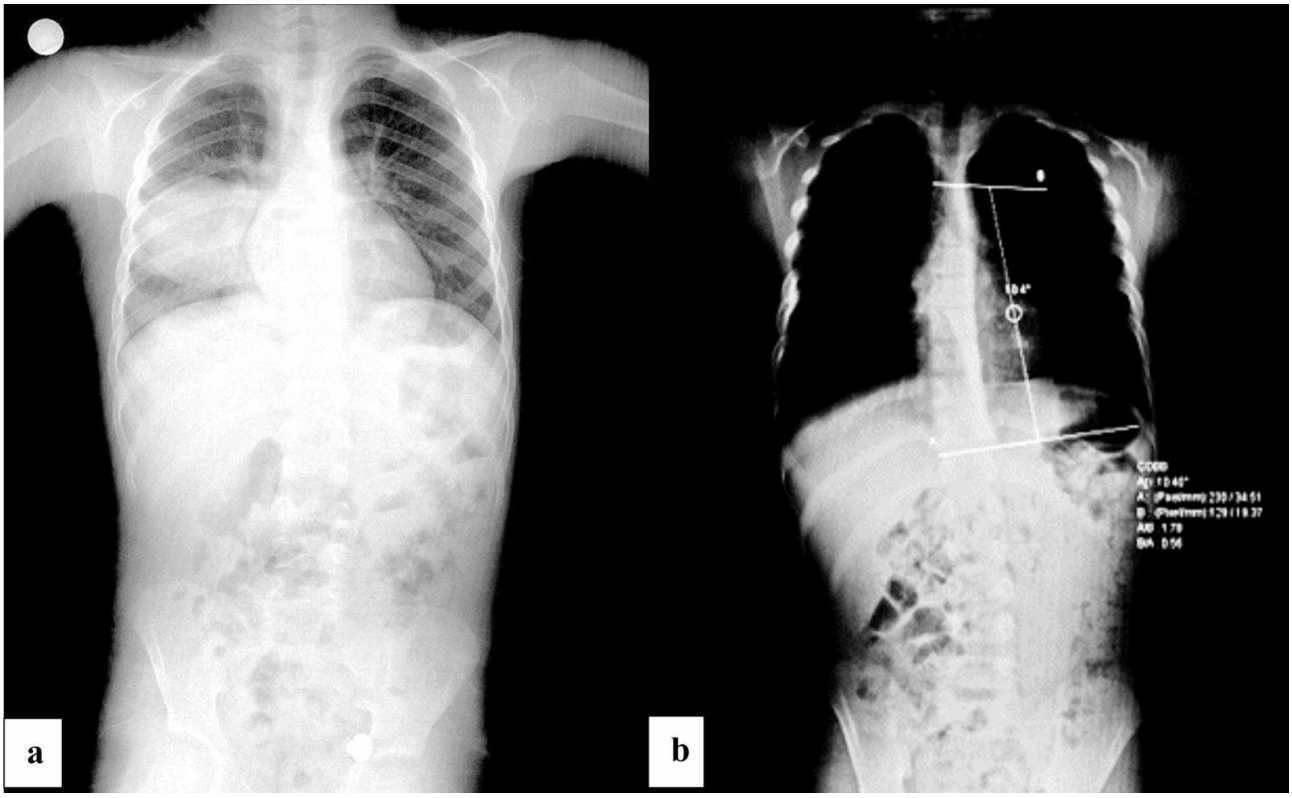

Fig. 2 **a** Preoperative pulmonary hydatid cyst direct radiograph image, **b** Cobb angle measurement of the patient at the 3rd postoperative year

Table 1 General descriptive statistics

		Count	%
Gender	Male	65	56,0
	Female	51	44,0
Thoracotomy Side	Right	55	47,4
	Left	38	32,8
	Bilateral	23	19,8
Spinal Deformity	Negative	49	42,2
	Positive	67	57,8
Spinal Deformity Apex Side	Negative	49	42,2
	Left	25	21,6
	Right	42	36,2
		Mean	**SD**
Thoracotomy Age (years) (n:116)		7,6	2,8
Cobb Angle (n:67)		6,6	2,4
Follow-up Time (month) (n:116)		52	28,1

SD: standart deviation

significant relationship between these two variables ($p = 0.048$). This finding suggests that the side of the thoracotomy may have an impact on the apex side of the spinal deformity. In most cases, the apex of the spinal deformity corresponds to the side of the thoracotomy.

Discussion

In this study, the incidence of spinal deformity in pediatric patients who underwent thoracotomy for pulmonary hydatid cyst disease was evaluated. The findings revealed that 57.8% of patients who underwent thoracotomy developed spinal deformity, and this condition was more prevalent in patients who underwent thoracotomy at younger ages. Despite the plethora of studies in the literature that have examined the development of spinal deformity subsequent to thoracotomy, there is an absence of research investigating the development of spinal deformity in thoracotomies performed for pulmonary hydatid cysts. Consequently, our study is an inaugural study that focuses on this issue in the literature.

As evidenced by the extant literature, spinal deformities are prevalent in pediatric patients following thoracic surgeries [13, 16, 17]. It has been reported that spinal deformity develops in 23–46% of children who undergo surgical intervention, particularly in cases of congenital heart disease. In the present study, the rate was 57.8%, which is slightly higher than that reported in other studies [7, 11, 13, 18]. The reason for this discrepancy is that the low socioeconomic level in our region can lead to disruptions in postthoracotomy care and rehabilitation. Consistent with the literature, spinal deformity after thoracotomy is predominantly mild to moderate and does not require treatment [10, 19].

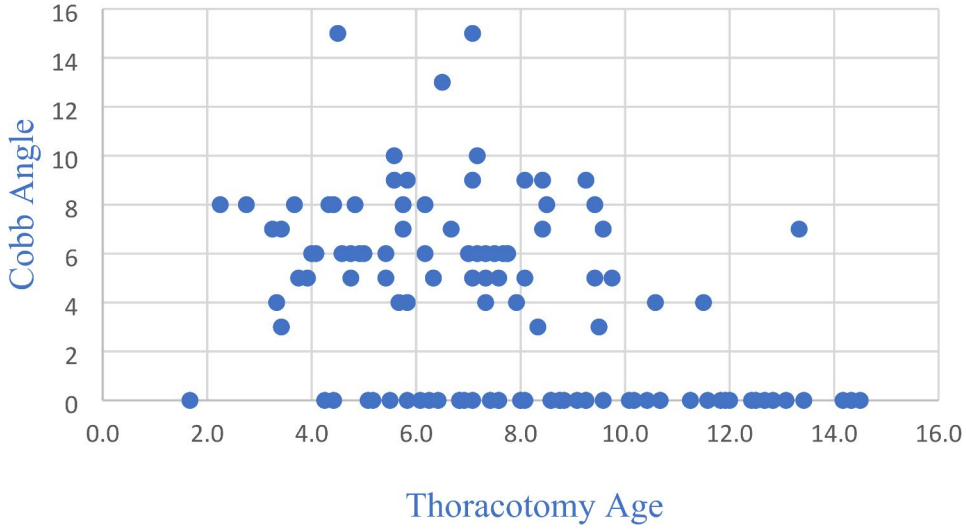

Fig. 3 Correlation between thoracotomy age and Cobb angle

Borselle et al. reported that less invasive surgical methods reduce the risk of spinal deformity [20]. This is especially true in thoracoscopic surgeries, where preservation of the chest wall muscles may significantly reduce the development of spinal deformity. In contrast, the present study revealed a high rate of spinal deformity in patients who underwent standard thoracotomy procedures. Damage to the latissimus dorsi and serratus anterior muscles, especially during thoracotomy, may lead to instability of the chest wall and the development of spinal deformity [20, 21].

In the present study, it was demonstrated that the side of thoracotomy may have an impact on the direction of the apex of the spinal deformity. The literature contains publications indicating that the spinal deformity curve subsequent to thoracotomy is generally concave towards the surgical side, i.e., the apex is on the opposite side [9, 12, 14]. However, these findings are not in accordance with the data presented in this study, which indicates that the apex of the spinal deformity in our study was predominantly in the same direction as the thoracotomy side. The relationship between the direction of the spinal deformity and the thoracotomy site is intricate and does not conform to a specific model [8].

A number of researchers have reported that sex has no significant effect on the development of spinal deformity [9, 12, 14]. In the present study, no statistically significant relationship was found between sex and the development of spinal deformity.

A review of the literature revealed that the risk of spinal deformity is greater in children who undergo surgical intervention during the period of rapid growth [18, 22, 23]. This study revealed that the risk of spinal deformity increased with decreasing thoracotomy age, which is in line with the findings of the literature [12].

A number of studies have reported that less invasive and muscle-sparing surgical techniques may reduce postoperative musculoskeletal complications, but their study was based on a limited group of patients; in contrast, our study included a larger group of patients and revealed a greater incidence of spinal deformity after thoracotomy, suggesting that the risk of complications associated with thoracotomy should not be underestimated [6, 24, 25].

An important feature of our study, which distinguishes it from other studies in the literature, is that 23 patients in our series underwent bilateral thoracotomy. Among these patients, 13 developed spinal deformity. This finding indicates that spinal deformity can be observed not only in patients who have undergone unilateral thoracotomy but also in patients who have undergone bilateral thoracotomy. Therefore, the risk of developing a spinal deformity after thoracotomy should be assessed regardless of the number of surgical sides and should be carefully monitored in patients undergoing bilateral thoracotomy.

An increased sample size would have enhanced the reliability of the study. The absence of a more protracted follow-up period and the paucity of prospective studies can be enumerated as constraints.

Conclusions

This study demonstrated that pediatric patients who have undergone thoracotomy for pulmonary hydatid cyst disease are predisposed to developing spinal deformity, with this risk increasing in younger age groups. This finding aligns with the conclusions of analogous studies in the literature, which indicate that the development of spinal deformities following thoracotomy is a multifactorial process influenced by factors such as age, surgical technique and the duration of the follow-up period.

Consequently, long-term follow-up, early detection and the initiation of physiotherapy are imperative to prevent or reduce the development of postthoracotomy spinal deformity in pediatric patients.

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Author contributions
SK, AK and BB contributed to the study design. SK and AK also carried out the data analysis. The manuscript was drafted by SK with contributions from BB and AK. All authors contributed to data interpretation, participated in revising the manuscript and approved the final version for submission.

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Data availability
All data are available from the corresponding author by request. All data generated or analysed during this study are included in this published article [and its supplementary information files].

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the Declaration of Helsinki and approved by the Noninterventional Health Research Ethics Committee of Yüzüncü Yıl University (Protocol No: 2024/11–28, approval date: 18/10/2024). Owing to the retrospective nature of the study and the anonymized data analysis, informed consent was not obtained from participants with the approval of the ethics committee.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Clinical trial number
Not applicable.

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