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Main features and treatments of cervical cysts in children from a single-center experience

Nian Sun[1†], Wei Pang[1†], Xuexi Zhang[1], Yanzhen Li[1], Qiaoyin Liu[1], Zhiyong Liu[1], Xiaodan Li[1], Junlong Tan[1], Shengcai Wang[1*] and Xin Ni[1*]

Abstract

Background The cervical cysts is one of the most common children ailments an ENT surgeon encountered, which often begins with painless masses in the neck. The present study summarizes main clinical features of various types of children cervical cysts and discusses the possible approaches and associated complications, with an aim to improve the diagnosis and treatment of this pediatric disease.

Methods We retrospectively analyzed the clinical data of patients admitted with cervical cyst to Beijing Children's Hospital, Capital Medical University from January 2018 to December 2023. Analysis focused on the clinical presentation, medical imaging, surgical approach, treatment-related complications as well as disease recurrence.

Results The main self-reported symptom at first admission was painless masses at neck and submandibular space accompanied by sleep apnea, laryngeal stridor, odynophagia or hoarse voice. Three hundred and eighty-four patients received cervical ultrasound examination, whereas 92 patients were subjected to cervical MRI. The median of cysts size recorded by medical imaging was 1.7 cm*1.0 cm*1.6 cm. The median operation duration was 55 min. Histology of removed cysts indicated five main pathological categories including thyroglossal duct cyst (TGDC), branchial cleft cyst (BCC), dermoid cyst (DC), lymphatic malformation (LM) and bronchogenic cyst (BC). The most frequent postsurgical complication was dysphagia and inflammatory wound swelling. Seven patients inflicted with relapses before further treatment.

Conclusions Comprehensive evaluation including medical history, physical examination, ultrasound and MRI imaging of cervical spaces is required to assure the proper diagnosis of cervical cysts in children. Surgical removal remains the major modality for disease control. Majority of postsurgical complications are attributed to transitional injury of blood vessels or nerves. Recurrence of cysts is commonly associated with patients with TGDC and LM.

Keywords Pediatric, Cervical cysts, Surgery

†Nian Sun and Wei Pang contributed equally to this work.

*Correspondence:
Shengcai Wang
wsc820329@163.com
Xin Ni
nixin@bch.com.cn
[1]Department of Otolaryngology-Head and Neck Surgery, Beijing Children's Hospital, Capital Medical University, National Center for Children's Health, 56# Nanlishi Road, Xicheng District, Beijing 100045, China

Background

The cervical cysts is one of the most common children ailments an ENT surgeon encountered. Painless masses in the cervical spaces are prominently found in new admissions [1]. Study on a large-size cohort revealed that cervical cysts, as a benign neoplasm, account for more than 55% of cases of cervical enlargement, a percentage higher than cervical lymphadenitis (27%) commonly due to infections [2]. Majority of cervical cysts is of congenital abnormal origin which can be classified based on locations and pathological characteristics as TGDC, BCC, DC, LM and BC. Among these different cervical cysts, TGDC is the most and common one following with BCC whereas DC and LM are rarely needed to be operated in ENT clinic [3]. Surgical removal is the pivot modality for treatment of children cervical cysts. Ultrasound-guided sclerosis treatment or microwave ablation is the applicable supplement measurement in case of relapse, or difficulty in complete removal due to structure of cyst locations [4]. The present study summarized main clinical features of various types of children cervical cysts and discussed the possible approaches and associated complications, with an aim to improve the diagnosis and treatment of this pediatric disease.

Materials and methods

Aim and study design

This study retrospectively summarized the main features of various types of cervical cysts.

Patients

Patients being recruited in this study were those diagnosed with cervical cysts and received surgical removal in Department of Otolaryngology, Head and Neck Surgery in Beijing Children's Hospital, Capital Medical University from January 2018 to December 2023. Four criteria were met as below: 1. age < 18 years old; 2. history of cervical mass; 3. subject of neck open surgery; 4. positive for cervical cyst upon pathological examination. This study was approved by the Ethics Committee of Beijing Children's Hospital in accordance with the Declaration of Helsinki ([2024]-E-088-R). All patients or their parents/guardians signed the consent of agreement for the present study.

Methods

Clinical data from all patients were retrospectively analyzed. These data included demographics of study subjects, main clinical presentations, size of neoplasm, diagnosis and pathological category. Meanwhile, the duration of surgical operation, locations of cysts and their structural relationship to blood vessels, nerves or other vital structures were discussed. Postoperative complications, time to follow-up relapse and approaches of secondary surgery were summarized too.

Statistics

All calculations were subject to statistical analysis using SPSS 27.0 software. Comparisons between cysts of different pathological groups were made when appropriate, and a p-value of less than 0.05 was considered statistically significant.

Results

Demographics and clinical presentations of five histopathology subtypes of cervical cysts

In the present study, data were retrieved from 386 cervical cysts patients who received surgery treatment in Beijing Children's Hospital. As listed in Table 1, patients with a median age of 59-month-old (age range from 20 days to 16.17 years old) comprised of 210 (54.4%) boys and 176 (45.6%) girls. While the majority of the patients admitted to hospital claimed neck and submandibular swelling as self-reported symptom (365/386, 94.5%), few patients admitted to hospital because of neck inflammatory redness, swelling and festering boil accompanied by local infection (21/386, 5.5%). The appearance of some cervical cysts is shown in Fig. 1. Recorded history of related local infection was confirmed with 81 (21.0%) patients amongst all subjects. Besides neck cysts, other perceivable clinical presentations accompanied include snore/dyspnea (13/386, 3.4%), dysphagia/sore throat (7/386, 1.8%), hoarseness/stridor (5/386, 1.3%), and choking (3/386, 0.8%). Histology classified cervical cysts into five groups with different subtypes. Among all subjects, 197 patients suffered with TGDC representing the most prevalent subtype of cervical cysts. Total 54 patients belong to BCC; 75 belong to DC and 51 patients with LM. Cases of BC were rare with only 9 patients. Worth to mention, no difference with regards to associated clinical presentations and/or preference to sex and age between each above-mentioned group were observed.

Location and adjoining structures of different cervical cysts in neck

Regardless of the histopathological subtype, submental triangle was the predominant spawn site of cervical cysts followed by muscular triangle. As for preferential locations of different subtypes, submental triangle and muscular triangle were the major sites for TGDC and DC while more than half of BCC cases occurred on carotid triangle. However, LM was found exclusively on carotid triangle, supraclavicular triangle and occipital triangle. To be noted, with very limited cases of BC which might cause bias in statistics, our study found that all BC appeared exclusively on muscular triangle (Table 2). Fibrous adhesion between cysts and blood vessels/nerves travelling through neck was commonly observed. In addition, adhesion could be found in other important

Table 1 Demographics and clinical presentations of study subjects

	Total (*N* = 386)	TGDC (*N* = 197)	BCC (*N* = 54)	DC (*N* = 75)	LM (*N* = 51)	BC (*N* = 9)	*P* Value
Age (months), median (range)	59(0.7 ~ 193)	61(12 ~ 177)	91.5(0.7 ~ 193)	54(8 ~ 158)	41(6 ~ 140)	46(4 ~ 62)	0.003
Duration (months), median (range)	6(0.1 ~ 156)	7(0.1 ~ 120)	4.5(0.13 ~ 156)	12(0.25 ~ 120)	4(0.25 ~ 110)	4(0.75 ~ 24)	0.011
Sex, n (%)							-
Male	210(54.4%)	125(63.5%)	28(51.9%)	24(32.0%)	28(54.9%)	5(55.6%)	
Female	176(45.6%)	72(36.5%)	26(48.1%)	51(68.0%)	23(45.1%)	4(44.4%)	
Presenting symptoms, n (%)							
Neck Cyst	365(94.6%)	181(91.9%)	49(90.7%)	75(100%)	51(100%)	9(100%)	-
Pain	62(16.1%)	39(19.8%)	10(18.5%)	2(2.7%)	10(19.6%)	1(11.1%)	-
Volume change							-
Enlarge	165(42.7%)	59(30.0%)	30(55.6%)	40(53.3%)	35(68.6%)	1(11.1%)	
Downsize	8(2.1%)	7(3.6%)	-	1(1.3%)	-	-	
Invariable	163(42.2%)	95(48.2)	17(31.5%)	31(41.3%)	14(27.5%)	6(66.7%)	
Recurrence	50(13.0%)	36(18.3%)	7(13.0%)	3(4.0%)	2(3.9%)	2(22.2%)	
Inflammatory redness/swelling	13(3.4%)	11(5.6%)	1(1.9%)	-	1(2.0%)	-	-
Festering boil	8 (2.1%)	6(3.0%)	2(3.7%)	-	-	-	
Accompany symptoms, n (%)							
Dysphagia/Sore throat	7(1.8%)	4(2.0%)	-	-	3(5.9%)	-	-
Hoarseness/Stridor	5(1.3%)	-	2(3.7%)	-	2(3.9%)	1(11.1%)	-
Snore/Dyspnea	13(3.4%)	-	4(7.4%)	-	7(13.7%)	2(22.2%)	-
Choking	3(0.8%)	-	1(1.9%)	-	1(2.0%)	1(11.1%)	-
Local Infection	81(21.0%)	57(28.9%)	15(27.8%)	2(2.7%)	6(11.8%)	1(11.1%)	

Fig. 1 The appearance of study subjects: **A.** The appearance of the TGDC: An oval mass in the middle of the neck; **B.** The appearance of the BCC: A round mass in the lateral neck, adjacent to the mandibular angle and the anterior edge of the sternocleidomastoid muscle (the second branchial cleft cyst); **C.** The appearance of the LM: Cystic mass in the lateral or posterior neck

anatomic structures such as parotid gland, submandibular gland and thyroid gland.

TGDC is typically situated in proximity to the hyoid bone and may extend from the base of the tongue to the thyroid gland. This anatomical relationship is corroborated by our findings (Table 2): among all patients with TGDC, 35 individuals (17.8%) exhibited significant adhesion to the hyoid bone, while 11 (5.6%) had extensions reaching the thyroid gland. Furthermore, 4 (2.0%) had cysts located adjacent to the lingual artery, and 5 (2.5%) to the hypoglossal nerve. In contrast, our study found that DC was rarely adjacent to neck structures. BCC and LM were often found in similar lateral neck areas, leading to a lack of specificity in adjoining structures. Table 2 showed that both were primarily associated with the cervical sheath (38.9% for BCC, 49.0% for LM). Additionally, BCC was close to the recurrent laryngeal nerve (6/54, 11.1%), the accessory nerve (7/54, 13.0%) and the hypoglossal nerve (6/54, 11.1%), whereas LM was close to the internal jugular vein (13/51, 25.5%) and the parasympathetic nerve (14/51, 27.5%). From our study, most of the BCs resided around the trachea and inferolateral region of thyroid gland (6/9, 66.7%). Cysts were often associated with the recurrent laryngeal nerve (7/9, 77.8%).

Table 2 Locations and adjoining structures of study subjects

	Total (*N* = 386)	TGDC (*N* = 197)	BCC (*N* = 54)	DC (*N* = 75)	LM (*N* = 51)	BC (*N* = 9)
Location, n (%)						
Submental triangle	174(45.1%)	132(67.0%)	-	42(56.0%)	-	-
Submandibular triangle	30(7.8%)	17(8.6%)	10(18.5%)	3(4.0%)	-	-
Carotid triangle	48(12.4%)	-	28(51.9%)	4(5.3%)	16(31.4%)	-
Muscular triangle	94(24.4%)	48(24.4%)	13(24.1%)	24(32.0%)	-	9(100%) *
Supraclavicular triangle	17(4.4%)	-	1(1.9%)	1(1.3%)	15(29.4%)	-
Occipital triangle	23(6.0%)	-	2(3.7%)	1(1.3%)	20(39.2%)	-
Adjacent vessels, n (%)						
Lingual artery	4(1.0%)	4(2.0%)	-	-	-	-
Thyroid vessels	4(1.0%)	-	2(3.7%)	-	2(3.9%)	-
Carotid sheath	50(13.0%)	-	21(38.9%)	1(1.3%)	25(49.0%)	3(33.3%)
Internal jugular vein	22(5.7%)	-	9(16.7%)	-	13(25.5%)	-
Common carotid artery	5(1.3%)	-	3(5.6%)	-	2(3.9%)	-
External jugular vein	2(0.5%)	-	-	-	2(3.9%)	-
Transverse cervical vessels	3(0.8%)	-	-	-	3(5.9%)	-
Subclavian vessels	3(0.8%)	-	-	-	3(5.9%)	-
Adjacent nerve, n (%)						
Cutaneous nerve	6(1.6%)	-	-	-	6(11.8%)	-
Vagus nerve	12(3.1%)	-	2(3.7%)	-	9(17.6%)	1(11.1%)
Facial nerve	9(2.3%)	-	5(9.3%)	-	4(7.8%)	-
Recurrent laryngeal nerve	15(3.9%)	-	6(11.1%)	-	2(3.9%)	7(77.8%)
Accessory nerve	21(5.4%)	-	7(13.0%)	-	14(27.5%)	-
Hypoglossal nerve	14(3.6%)	5(2.5%)	6(11.1%)	-	3(5.9%)	-
Phrenic nerve	2(0.5%)	-	1(1.9%)	-	1(2.0%)	-
Cervical/Brachial nerve	8(2.1%)	-	-	-	8(15.7%)	-
Infringement of structures, n (%)						
Parotid gland	10(2.6%)	-	4(7.4%)	-	6(11.8%)	-
Submandibular gland	9(2.3%)	-	3(5.6%)	-	6(11.8%)	-
Thyroid	25(6.5%)	11(5.6%)	7(13.0%)	-	2(3.9%)	5(55.6%)
Hyoid bone	37(9.6%)	35(17.8%)	-	2(2.7%)	-	-
Pharynx/Larynx/Trachea/Esophagus	17(4.4%)	9(4.6%)	2(3.7%)	-	-	6(66.7%) *

*: 6 of all 9 patients resided in the area around the trachea or inferolateral region of thyroid gland

Imaging evaluation of cervical cysts

In the present study, 384 patients received ultrasonography examination and 92 patients were subjected to MRI examination. The medical imaging agreed with the clinical impression that cervical cysts occur in multiple sites of the neck. As far as cyst size was concerned, medical imaging revealed that the median size of cyst was 1.7 cm*1.0 cm*1.6 cm, BCC, LM and BC generally present with greater size (Table 3).

Surgical procedure and post-op follow-up

All patients in the present study were subjected to open surgery for cysts removal under general anesthesia. Complete resection of whole cysts region was ensured without causing collateral damage of adjacent tissues. The rate of the overall complications after surgery of cervical cysts was 16.3% (63/386) in our study cohort. The most common post-op complication was swallowing discomfort (26/386, 6.7%), wound redness and swollenness (14/386, 3.6%) (Table 4). The Sistrunk procedure was the main approach for TGDC in our study (191/197, 97.0%). Our surgical procedures were shown in Fig. 2A and B. After resection of the main cyst, we continued to explore and ligate the posterosuperior region of hyoid along the root of the cyst, and excised the central part of the hyoid bone together. Nevertheless, some cases still suffered from complications such as swallowing discomfort (23/197, 11.7%) and slanted tongue (3/197, 1.5%) due to spreading and extending lesions in a large area (Table 4). This pinpointed the importance of mindfulness to the anatomy of pharyngeal mucosal structure and the associated blood vessels and nerves during TGDC operation. DC is superficial and therefore rarely causes complications after complete resection. The range of lesions in BCC and LM cases was relatively large, especially LM (Fig. 2C, D and E). Therefore, in addition to complete resection of the lesion, avoiding damage to the adjacent structures shown in Table 2 was necessary to ensure the success

Table 3 Medical imaging evaluation of study subjects

	Total (*N* = 386)	TGDC (*N* = 197)	BCC (*N* = 54)	DC (*N* = 75)	LM (*N* = 51)	BC (*N* = 9)	*P* Value
Main investigation, n (%)							-
US	384(99.5%)	197(100%)	54(100%)	75(100%)	49(96.1%)	9(100%)	
MRI	92(23.8%)	16(8.1%)	26(48.1%)	3(4.0%)	41(80.4%)	6(66.7%)	
US + MRI	90(23.3%)	16(8.1%)	26(48.1%)	3(4.0%)	39(76.5%)	6(66.7%)	
Size assessment, median (range)							
Left and right diameter (cm)	1.7(0.3 ~ 9.1)	1.5(0.4 ~ 6.8)	3.2(0.3 ~ 6.8)	1.2(0.3 ~ 4.2)	3.8(1.1 ~ 9.1)	3.4(1.9 ~ 5.7)	<0.001
Front and rear diameter (cm)	1.0(0.2 ~ 7.1)	0.9(0.2 ~ 5.1)	2.4(0.3 ~ 6.7)	0.8(0.3 ~ 2.7)	2.8(0.7 ~ 7.1)	2.3(1.4 ~ 3.0)	<0.001
Upper and lower diameter (cm)	1.6(0.2 ~ 8.3)	1.3(0.2 ~ 8.2)	3.0(0.3 ~ 6.4)	1.1(0.4 ~ 3.5)	3.9(1.0 ~ 8.3)	3.6(2.0 ~ 4.9)	<0.001

US: ultrasonography; MRI: magnetic resonance imaging

Table 4 Surgery and hospitalization of study subjects

	Total (*N* = 386)	TGDC (*N* = 197)	BCC (*N* = 54)	DC (*N* = 75)	LM (*N* = 51)	BC (*N* = 9)	*P* Value
Hospitalization (days), median (range)	7(1 ~ 26)	7(1 ~ 11)	7(1 ~ 26)	6(1 ~ 9)	8(2 ~ 19)	7(4 ~ 12)	<0.001
Time of surgery (minutes), median (range)	55(12 ~ 200)	55(20 ~ 150)	65(18 ~ 125)	25(12 ~ 120)	90(23 ~ 200)	85(70 ~ 120)	<0.001
Neurological monitor, n (%)							-
Y	45(11.7%)	2(1.0%)	16(29.6%)	5(6.7%)	14(27.5%)	8(88.9%)	
N	341(88.3%)	195(99.0%)	38(70.4%)	70(93.3%)	37(72.5%)	1(11.1%)	
Complications, n (%)	63(16.3%)	30(15.2%)	10(18.5%)	1(1.3%)	22(43.1%)	-	-
Red and Swollen	14(3.6%)	3(1.5%)	3(5.6%)	-	8(15.7%)	-	
Anemic	4(1.0%)	-	-	-	4(7.8%)	-	
Dyspnea	4(1.0%)	-	2(3.7%)	-	2(3.9%)	-	
Swallowing discomfort	26(6.7%)	23(11.7%)	3(5.6%)	-	-	-	
Facial paralysis	5(1.3%)	-	1(1.8%)	-	4(7.8%)	-	
Hoarseness/Choking	4(1.0%)	1(0.5%)	1(1.8%)	-	2(3.9%)	-	
Horner syndrome	2(0.5%)	-	-	-	2(3.9%)	-	
Hypoglossal nerve paralysis	4(1.0%)	3(1.5%)	-	1(1.3%)	-	-	
Follow-up (months), median (range)	6(1 ~ 62)	7(1 ~ 62)	6(1 ~ 42)	2(1 ~ 6)	15(1 ~ 57)	9(1 ~ 25)	-
Recurrence, n (%)	7(1.8%)	3(1.5%)	-	-	4(7.8%)	-	-

of the operation. In this study, complications primarily involved local swelling and redness from extensive resection (5.6% for BCC and 15.7% for LM), as well as facial paralysis, hoarseness, or Horner syndrome due to nerve damage (Table 4). Due to the deep location of the BC, the cyst compresses structures such as the trachea and usually requires immediate surgery, which can be challenging (Fig. 2F). There were no complications in all BC cases in this study, due to the use of nerve monitoring during the operation.

The median time of all surgeries was 55 min. Surgeries for LM and BC took longer duration with median time 90 and 85 min, respectively. Median time for removing DC was 25 min, the shortest operation time, although some of the DC cases also required 2 h.

In the present study, histopathological subtypes of the cervical cysts in majority of the patients (289/386, 74.9%) judged from pre-op evaluation were confirmed by post-op biopsy. The median days of hospitalization was 3 days spanning from 1 to 16 days. While patients of different cervical cysts had relatively similar hospitalization days, patients of LM had a tendency for longer stay in hospital (Table 4).

The median post-op follow-up time was 6 months (from 1 month to 5.17 years). The median follow-up time for LM patients was 15 months (from 1 month to 4.75 years) representing the cyst subtype with the longest follow-up time in our study cohort (Table 4). While cysts in majority of patients achieved completely remission, 7 patients including 3 TGDC, 4 LM suffered from recurrent cysts from 4 months to 4.75 years after first surgery. Fortunately, all of them eventually recovered either from secondary surgery, microwave ablation or sclerotherapy (Table 5).

Discussion

Cervical cysts in children are mostly of congenital nature with a broad spectrum of clinical presentation and onset time. Some are noticeable with swelling on the neck or oppression symptom not long after birth, some are easily ignored because the perceivable symptoms are found until adult or accompanied with the acute infection. TGDC, BCC, DC and LM are frequent cervical cysts

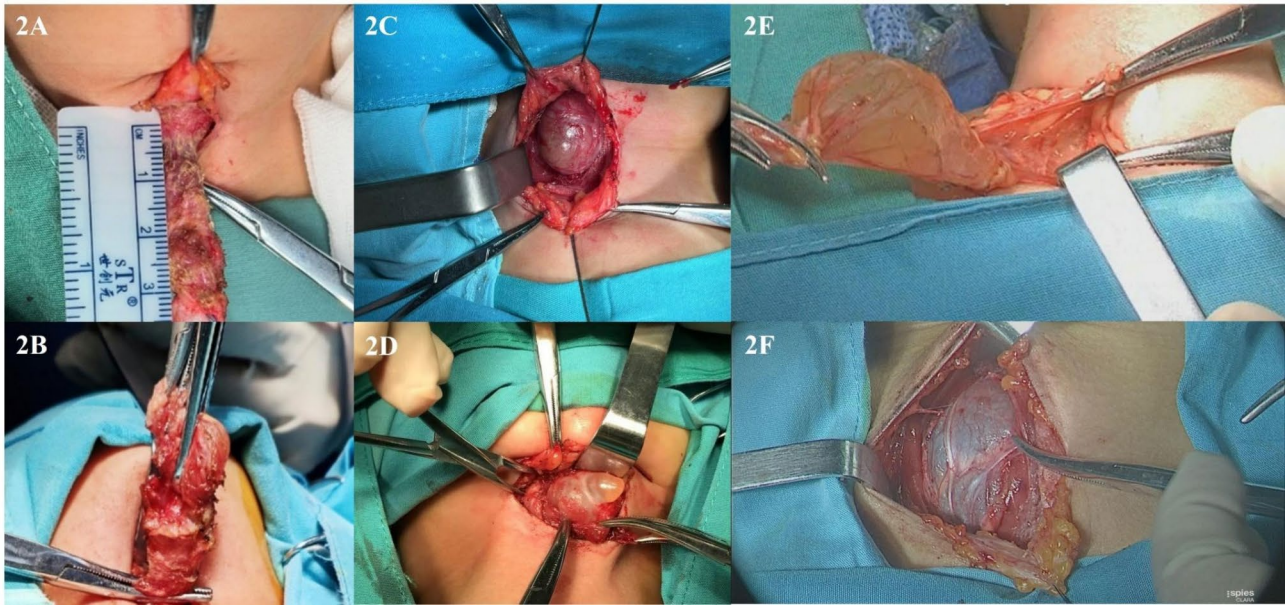

Fig. 2 The surgical images of study subjects: **A**, **B.** TGDC (the Sistrunk procedure): Excision included cyst, duct, central part of hyoid bone and its associated root tissue bundle; **C**, **D.** The second branchial cleft cyst: The cyst was removed and the mandibular marginal branch of facial nerve was protected; **E.** LM (occipital triangle area): Complete excision of the cyst and proper protection of the accessory nerve and its branches; **F.** BC: The recurrent laryngeal nerve was properly separated and protected on the surface of the cyst, and the cyst and the cartilage at the root of the cyst were completely resected

Table 5 Clinical details of the 7 recurrent patients

	Sex/Age	Diagnosis	Size(cm)	Time to recurrence	Investigation of recurrence	Second treatment	Follow-up
Patient 1	M/4yrs	TGDC	1.3*0.8*1.2	7mo	Symptoms	Surgery	Resolved
Patient 2	M/9yrs	TGDC	2.3*0.9*1.3	11mo	US	Surgery	Resolved
Patient 3	M/3yrs	TGDC	2.7*0.8*2.0	3yrs	Symptoms + US	Sclerotherapy	Resolved
Patient 4	F/11yrs	LM	8.2*2.9*5.8	4.75yrs	US	MAT + Sclerotherapy	Resolved
Patient 5	F/5yrs	LM	8.0*6.2*2.4	4.75yrs	US	Sclerotherapy	Resolved
Patient 6	M/6mo	LM	4.6*5.7*4.3	4mo	Symptoms + US	Sclerotherapy	Resolved
Patient 7	F/8mo	LM	2.4*6.2*4.3	1yrs	Symptoms + US	Surgery + Sclerotherapy	Allergy

mo: months; yrs: years; M: male; F: female; US: ultrasonography; MAT: microwave ablation therapy

in children, while BC and thymic cyst are rare cases. In our study cohort, we found few cases of BC and no cases for thymic cyst. Regardless of the cyst subtype, surgical removal is the primary remedy for cervical cysts in children [1]. The surgery should avoid time of acute infection in order to minimize the potential treatment-related damage on blood vessels and nerves [5]. It has been suggested ultrasound-guided sclerotherapy or endoscopic resection provide great benefits for tissue protection or cosmetically consideration [4].

Being different in histological and embryonic initiation, cervical cysts in children are associated with various clinical presentation, occurrence location and onset time.

TGDC is developmental residue derived from thyroid primordium failed to migrate to trachea through Morand's foramen and commonly resides in anterior neck around the middle line [3]. The neck masses in patients of TGDC often move up and down synchronized with swallowing due to the attachment of cysts with hyoid. Previous studies revealed that majority of TGDC onset time is around 5 years old [6]. This agrees with our study cohort in that the median onset time of TGDC was 61 months (Table 1). BCC derives from developmental embryonic anomaly of incomplete closure of branchial cleft. It occurs anywhere from ear lobe to collarbone region and contains four subtypes (first to fourth branchial cleft cysts) [7]. Majority of BCC originated from second branchial cleft, which go along with sternocleidomastoid all the way to tonsillar fossa, coexisting with the path of carotid artery sheath, hypoglossal nerve, glossopharyngeal nerve. Therefore, most of the second branchial cleft cysts reside on the lateral side of the neck from submandibular space to supraclavicular space [8]. Data based on our study cohort indicated that all of the BCC cases belong to second branchial cleft cysts and carotid triangle (28/54, 51.9%) was the most frequent occurring space. Enlarged BCC commonly cause asymmetric neck resulting in difficulties in

breathing, swallowing and vocalization [9]. In our study, 2 (3.7%) BCC patients had hoarse voice, 4 (7.4%) patients presented with snore and sleep apnea and 1 (1.9%) patient had choking, mostly caused by mass oppression to adjacent structures. Although it is well-documented that BCC has no preferential onset age [10], in our study cohort, the median onset time of BCC was 91.5 months, an age significantly older than other types of cervical cysts. This could be a data bias from limited sample size, or implies that BCC has a skewed trend for later onset compared to other neck cysts in children. DC is general terminology for various ectodermic abnormality including dermoid cyst and epidermoid cyst. It often occurs in the regions near mouth floor and hyoid bone. In contrast to TGDC, it does not move together with hyoid bone due to its superficial location. Nevertheless, in clinical practice, it is not uncommon to misdiagnose DC as TGDC before surgery. As exemplified in our study, 19 (25.3%) DC patients were misdiagnosed as TGDC before post-op histopathological evidence being provided. Cervical LM derives from the obstructive embryonic lymph-vessel in the neck, mostly around jugular lymph sac. The lesion of LM frequently occurs in occipital triangle and has close association with carotid sheath [11]. In our study, all cervical LM lesions occurred in regions of carotid triangle, occipital triangle and supraclavicular triangle, in congruent with previous description [12]. The median onset age of LM in our study cohorts was 41 months but stretch to 140 months. Previous reports revealed that the onset time of LM prevails before 2 years old [13]. The broad distribution of LM patient age in our center was largely because parents or guardians delay in resorting to medical treatment. Enlarged LM, similar [3] to other types of cysts would cause oppression to adjacent structures to block breathing and swallowing. Seven (13.7%) LM patients in our study presented with symptoms of airway compression (snore/dyspnea). BC develops sporadically (1/42000 ~ 1/68000) from failure in anterior intestine and notochord separation during embryogenesis [14]. Previous study revealed the occurrence peak of BC is below 6 years old for children, and mostly in the neck [15]. It has been reported to occur in multiple regions on the neck including thyroid gland, skin, parapharyngeal space, paratracheal space, soft palate, mouth floor, posterior pharyngeal wall and arytenoid cartilage [14, 16–18]. Interestingly, all of 9 cases of BC in our study grew in the region of muscular triangle. BC usually presents as an asymptomatic mass, which is often misdiagnosed as other types of cysts or masses, especially BCCs [18, 19]. Similar to other cysts, enlarged BC mass causes snoring, dyspnea and difficulty in swallowing, severity of which are determined by the mass size and location [16, 20]. In our study, 5 out of 9 BC patients were symptomless, 4 patients had hoarse voice, snoring or choking.

Surgical resection is currently the main treatment for cervical cysts [21]. The present study was the single-center study providing the largest sample size in the world so far to our best knowledge. The median surgical time in our study was 55 min and the post-op relapse was only 1.8% (7/386), both of which were better than other studies [22, 23]. This could be a result benefiting from the complete removal of the lesions and effective protection of adjacent functional structures during operation. Early surgical intervention is the key to TGDC management: a study analyzing 340 pediatric cases found that the median age of surgery was 47.5 months, 13.5 months earlier than in our study, and symptomatic cystic infections and pathological inflammation increased significantly with age [24]. It's worth noting that although our study focused on the surgical experience of LM, the management of LM usually involves a combination of surgical excision and sclerotherapy. Sclerotherapy is a minimally invasive procedure that can effectively reduce the size of cysts [25], whereas surgical removal may be necessary for more extensive or symptomatic lesions, particularly those do not respond well to sclerotherapy. In some cases, the combination of surgery and intraoperative bleomycin irrigation has been shown to improve prognosis, especially in microcystic or mixed-type malformations [26]. As mentioned in the results, some cysts, such as BCC, LM, and BC, are closely related to the cervical nerves. In our center, 45 patients (11.7%) underwent intraoperative nerve monitoring, most of which were BCC, LM, and BC. When preoperative evaluation suggests that cysts are closely related to cervical nerves, intraoperative nerve monitoring is adopted to prevent cervical nerve injury [27].

In our study, 3 TGDC and 4 LM relapsed in all of follow-up cases. Our impression is that the disease recurrence is related to the tissue adhesion from multiple infections and diffused growth of cysts spreading to a large space that makes the complete removal in difficulty.

Conclusion

Comprehensive evaluation including medical history, physical examination, ultrasound and MRI imaging of cervical spaces is required to assure the proper diagnosis of cervical cysts in children. Surgical removal remains the major modality for disease control. Majority of postsurgical complications is attributed to transitional injury of blood vessels or nerves. Recurrence of cysts is commonly associated with patients with TGDC and LM.

Abbreviations

TGDC	Thyroglossal duct cyst
BCC	Branchial cleft cyst
DC	Dermoid cyst
LM	Lymphatic malformation
BC	Bronchogenic cyst

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Not applicable:

Author contributions
N.S. and W.P. have made the same substantial contributions to the conception and design of the work: the acquisition, analysis, and interpretation of data. X.Z., Y.L., Q.L., Z.L., X.L., and J.T. collected and organized patients' information and test results. S.W.and X.N. drafted the work or substantively revised it. All authors read and approved the final manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
This study was approved by the Ethics Committee of Beijing Children' s Hospital in accordance with the Declaration of Helsinki ([2024]-E-088-R). All patients or their parents/guardians signed the consent of agreement for the present study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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