The diagnosis, clinical course and follow-up of children with cardiac tumours – a single-centre experience

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Abstract

Background: Rhabdomyoma is the most frequent primary cardiac tumour in children (about 50% of all cardiac neoplasms in this population). Fibroma, myxoma, teratoma and haemangioma are less frequent.

Aim: To investigate the clinical presentation, diagnosis and follow-up of children diagnosed with cardiac tumours in our department between 1993 and 2008.

Methods: In the 15-year review we found 9 cases of cardiac tumours, confirmed in echo scan in every case and pathomorphologically in 5 out of 9 cases.

Results: Cardiac tumours were found in six boys and three girls, usually in the neonatal period. Cardiac murmur was the most common clinical symptom (4 cases). Two children were symptom-free. Out of the remaining children, two had circulatory failure and one had arrhythmia. Five children were operated on: three cases of rhabdomyoma, one fibroma and one teratoma. In 3 children who did not undergo surgery, the most probable diagnosis was rhabdomyoma. The follow-up (possible in 8 out of 9 cases, mean 7 years) showed that six children developed regularly and in two cases neurological abnormalities appeared.

Conclusions: In this series, primary cardiac tumours presented as murmurs or circulatory failure. Most children needed surgery. In most cases, pathomorphology revealed rhabdomyoma. Follow-up showed regular development in six out of nine cases.

Key words: heart tumours, rhabdomyoma, diagnosis, children

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Introduction

The real prevalence of heart tumours in children is difficult to estimate since the available data are restricted to autopsy and case records from leading paediatric centres. It is believed that they constitute less than 0.1% of all neoplasms and occur with an incidence of 0.0017 to 0.28 in autopsy records [1-4]. Beghetti et al. found that among 27 640 patients examined echocardiographically in 5-year periods, the incidence of cardiac tumors increased: 0.06% (1980-1984), 0.22% (1985-1989) and 0.32% (1990-1995) of all the subjects [5].

Cardiac neoplasms can be either primary or secondary (metastatic). The majority of heart tumours in children (about 90%) are benign; however, how threatening they are depends on their location. Incidence of particular cardiac tumour histological types depends on the age of the examined population [6-8]. While in adults myxomas are most common, in the paediatric population the most prevalent are rhabdomyomas, which are benign tumours and account for 50% of all primary cardiac tumours in children. In children, rhabdomyoma is followed by fibroma, myxoma, teratoma, and haemangioma [7, 8]. Common malignant primary tumours are angiosarcoma, fibrosarcoma, lymphosarcoma, and giant cell sarcoma [5, 6]. Secondary tumours (usually simultaneously affecting both the myocardium and the pericardium) are encountered more frequently than primary ones. The most common secondary cardiac neoplasms in the paediatric population are non-Hodgkin lymphoma, leukemic infiltration, and neuroblastoma. There have also been reported cases of nephroblastoma located along the inferior caval vein, protruding into the right atrium, and even into the right ventricle through the tricuspid valve [5, 6].

Echocardiography, computer tomography (CT) and magnetic resonance imaging (MRI) of the heart are the main non-invasive diagnostic procedures [5, 6, 9]. Angiography, which used to be regarded as the gold standard, is now only applied in certain cases due to its invasive nature [5]. In cardiac tumour diagnostics, ECG is non-specific; however, its

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importance must not be underestimated since the presence of significant cardiac arrhytmia indicates the need for surgery [9]. A chest x-ray is not decisive either, but it may show an enlarged heart silhouette or abnormal cardiac contours.

The aim of our study was to analyse clinical presentation, diagnosis, and follow-up of children affected by cardiac tumours.

Methods

We reviewed 9 cases of children (6 boys and 3 girls) with cardiac tumours treated at the Department of Paediatric Cardiology between 1993 and 2008. In all the cases, ECHO was performed as an essential diagnostic procedure (we used Hewlett Packard Sonos 4500 ultrasound), and so were a chest x-ray, and ECG. In those children who did not require urgent surgery we also applied 24-hour ECG monitoring. Two children had chest and abdominal CT. A histological character of tumours was established on the basis of resected specimens.

Results

Detailed demographic and clinical data of studied children are shown in Table I.

In seven cases, cardiac tumours were diagnosed in infancy, between the second and the ninth month of life; one child was diagnosed at three years of age. In one case tumor tissue was discovered prenatally, in the 36th week of pregnancy, and they were multiple tumours of the right and left ventricle with no heart failure (HF) symptoms. The foetus was echocardiographically monitored until birth and then transferred to the cardiology department, where the initial diagnosis was confirmed. Despite the substantial size of the lesions, the child was asymptomatic throughout the whole neonatal and infancy periods.

The remaining eight children were referred to a paediatric cardiologist because of heart murmur in four cases, in one case – due to arrhythmia, and one – due to tuberous sclerosis affecting the central nervous system and the kidneys. Other two children presented with unexplained HF symptoms. They were a 6-month-old infant (Table I, case 7) and a 3-year-old boy (case 8) admitted in poor general condition with shortness of breath, tachypnoe, tachyrhythmia, as well as jugular venostasis, and enlarged liver. At the time of diagnosis, the remaining seven children were in good condition with no manifestations of circulatory and respiratory insufficiency.

In the neonate with acute HF, echocardiography revealed a cardiac tumour. It was 7 cm^2 in size and occupied almost the whole right atrium obstructing the right ventricular inflow tract. Abdominal CT in this case excluded other tumours, including nephroblastoma. In the 3-year-old boy there was a round tumor mass, 40 cm^2 in size, which was connected to the pericardium. The neoplasm compressed the right heart, which resulted in the peripheral venostasis

Table I. Demographic and clinical characteristics of studied children

Case no.	Age at diagnosis	Gender	Symptoms	ECHO tumours location / size	Surgery	Pathomorphology	Follow-up
1	2 months	M	cardiac murmur	tumour in RVOT / 0.25 cm	elective	rhabdomyoma	normal development, 4-year follow-up
2	6 months	F	cardiac murmur	tumour in LVOT / 0.3 cm	urgent	rhabdomyoma	tuberous sclerosis, epilepsy, 15-year follow-up
3	9 months	M	cardiac murmur	tumour in IVS, protruding into RV / 1.75 cm	elective	rhabdomyoma	normal development, 6-year follow-up
4	2 months	M	cardiac murmur	tumour in RV / 0.17 cm	no	-	probably rhabdomyoma, no follow-up
5	36th week of pregnancy	F	asymptomatic	3 tumours (the biggest 2.42 cm in RV, 2 in LV)	no	-	probably rhabdomyoma, tuberous sclerosis, spontaneous regression before 20th month of life
6	3 months	M	asymptomatic, referred because of a different, previously diagnosed disease	tumour in RV / 0.35 cm	no	-	probably rhabdomyoma, tuberous sclerosis, spontaneous neurological disorders, 2-month follow-up
7	6 months	M	heart failure	tumour in RA / 7 cm	urgent	fibroma	normal development, 14-year follow-up
8	3 months	M	heart failure	intrapericardial tumour / 40 cm	urgent	teratoma	normal development, (only one-year follow-up, lost from follow-up)
9	4 months	F	arrhythmia	tumour in LV / 26 cm pericardial effusion	no	-	periodic pericardial effusion, normal circulation, 4-year follow-up

Abbreviations: RA – right atrium, RV – right ventricle, LV – left ventricle, IVS – intraventricular septum, mths – months, RVOT – right ventricular outflow tract, LVOT – left ventricular outflow tract, M – male, F – female

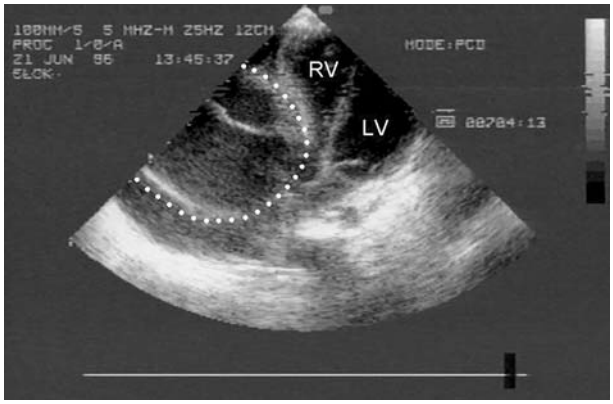

Figure 1. Echocardiography – pericardial teratoma – the area marked shows the tumour compressing the right heart – the subcostal four-chamber view
RV – right ventricle, LV – left ventricle

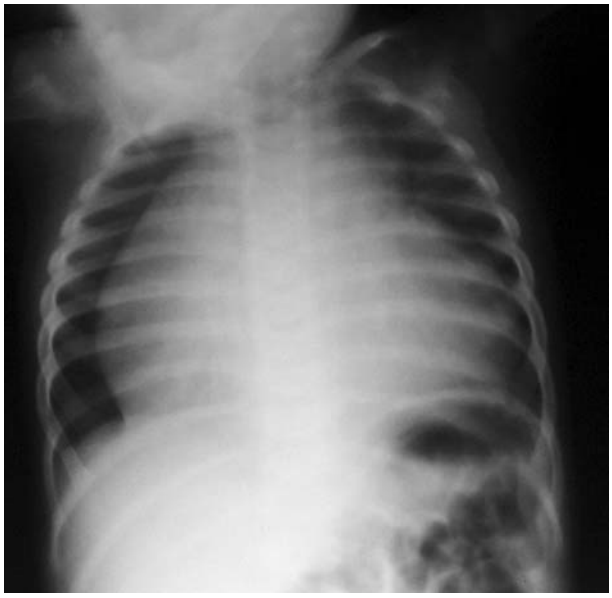

Figure 2. Chest X-ray – infant affected by pericardial teratoma

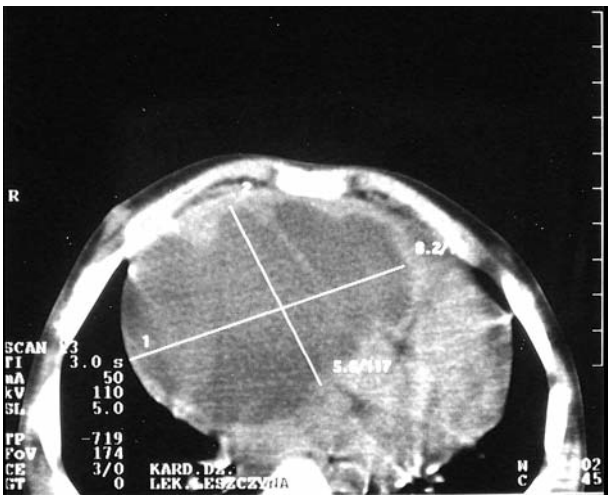

Figure 3. Chest CT – child with pericardial teratoma (marked)

and right ventricular outflow tract obstruction (Figure 1). Intrapericardial location of the mass was established on the basis of a CT scan (Figures 2, 3). Both patients required urgent surgery. Histopathology revealed a fibroma in the infant, and a teratoma in the other child.

In the child who was diagnosed during pregnancy (case 5), echocardiography performed postnatally confirmed multiple cardiac tumours. They were three well circumscribed masses with homogenous echo patterns. The biggest one originated in the ventricular septum and protruded into the right ventricle. The remaining ones were situated in the left ventricle and did not cause hemodynamic disorders or arrhythmia (Figure 4). Follow-up examinations showed gradual regression of the tumours and then their complete disappearance in the child's 20th month of life.

In the four-month-old girl (case 9), who was referred because of arrhythmia (ventricular premature contractions) an echocardiogram revealed a tumour, 55 × 59 mm in size, arising from the left ventricular free wall and protruding into the left ventricle. It was also observed that fluid gathered periodically in the pericardial sac (Figures 5, 6).

The remaining subjects had single neoplasms (Figure 7). In three children (case 1, 4, 6) the tumours were located in the right ventricular outflow tract and only one of them obstructed the pulmonary orifice (case 1).

In the 6-month-old girl (case 2), a pedunculated tumoral lesion, 0.3 cm^2 in size, was found in the left ventricular outflow tract and obstructed the blood flux into the aorta (the systolic gradient was 100 mmHg). The infant was urgently operated on. Histological analysis showed the mass to be a rhabdomyoma.

In the nine-month-old boy (case 3) with cardiac murmur, echocardiography revealed a tumour, 1.75 cm^2 in size, arising in the ventricular septum and protruding into the right ventricle. Due to the size and location of the lesion, the tumour was resected. Its histopathological character was that of a rhabdomyoma.

Only one child (case 9) had arrhythmia, which was the reason for referral. A 24-hour ECG recorded single ventricular extrasystoles. They did not require pharmacological treatment. The remaining children had no heart rhythm disorders or conduction abnormalities.

The tumour was excised in 5 out of 9 cases. Three children underwent urgent surgery (two with HF and the infant with the left ventricular outflow tract obstruction). Two children without HF symptoms and without arrhythmias were operated on as previously planned. Due to good general condition and lack of hemodynamic impairment, the remaining four children were under observation. Spontaneous regression of multiple tumours took place only in one of them (case 5). In the remaining three subjects, further years of follow-up showed no changes in the size of lesions.

Histopathological analysis in three out of five children who were operated on proved the tumours to be

rhabdomyomas (case 1, 2, 3). The tumour in the right ventricle (case 7) was a fibroma, while in the three-year-old boy the neoplasm resected from the pericardium appeared to be a teratoma.

All the children with rhabdomyomas were also examined for tuberous sclerosis. Only one child was affected (case 2). Tuberous sclerosis was also suspected in children who did not have surgery and whose echocardiogram was suggestive of rhabdomyoma. However, only one patient, in whom there was spontaneous regression of multiple tumours, later developed Bourneville disease (calcification in the central nervous system revealed in a CT scan of the head). Another child earlier diagnosed with Bourneville's disease (case 6) had a tumour in the right ventricle.

Discussion

Histopathological confirmation was obtained in 5 out of 9 cases. In one of the children (case 5) there was spontaneous regression of multiple heart tumours. Such cases have been reported in the literature and usually refer to rhabdomyoma [10-12]. In case 4, the echocardiographic image and the location in the right ventricle were suggestive of a rhabdomyoma. Similarly, in case 6 neurological disorders typical of tuberous sclerosis were also observed. Therefore, the diagnosis of rhabdomyoma was certain in three cases and probable in three other ones. This is in line with data from the literature [10-12] confirming the fact that rhabdomyoma is the most frequent lesion among all cardiac tumours in patients at a paediatric age.

Rhabdomyoma may be detected prenatally (as it happened in case 5); however, the majority are diagnosed in infancy. Clinical presentation and hemodynamic complications depend on the number, location and size of lesions. Rhabdomyoma (especially multiple) affects about 50% of children suffering from tuberous sclerosis. What is more, it is believed that about 50% of children affected by tuberous sclerosis have Bourneville's disease, which is an autosomal – dominant illness (case 2 and probably case 4, 5, 6). In this disease, the degree of penetration and gene mutation expression on the long arm of chromosome 9 differ from one another. Rhabdomyoma in this syndrome is usually asymptomatic, and the wide range of clinical forms presents gradually as the child develops. Typical symptoms are epilepsy, severe mental retardation associated with adenoma sebaceum (overgrowth of the sebaceous glands) of the face, cerebral cortical tubers (hence the name 'tuberous sclerosis') and hamartomatous tumours of the heart and kidney [13].

It is worth emphasising that some rhabdomyomas, even if large, spontaneously diminish or even disappear completely [10, 11]. That is why surgery should only be thought necessary in children with life-threatening hemodynamic abnormalities or arrhythmias (case 1, 2, 3).

Other histopathologically confirmed tumours in this series are fibroma and teratoma. Fibroma is the second

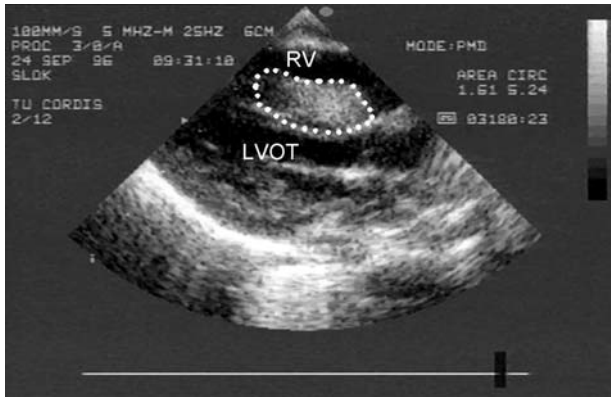

Figure 4. Echocardiography – multiple tumours in an infant – area marked is the biggest tumour, which is protruding into the right ventricle – the parasternal long axis view

RV – right ventricle, LVOT – left ventricular outflow tract

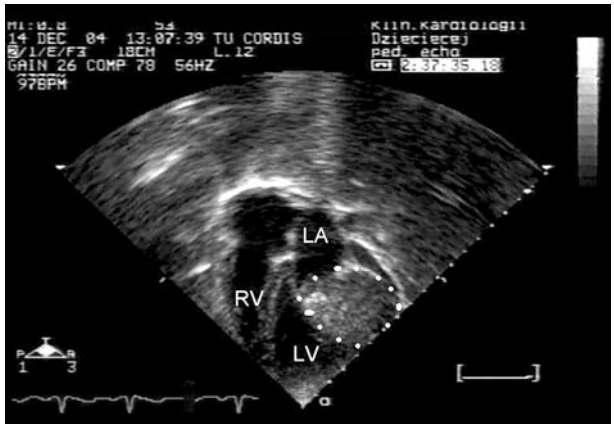

Figure 5. Echocardiography – tumour (marked) protruding into the left ventricle – the apical four-chamber view

LA – left etrium, RV – right ventricle, LV – left ventricle

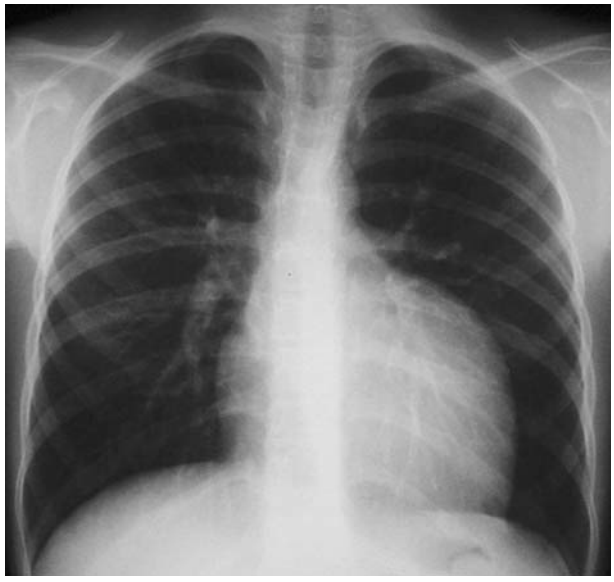

Figure 6. Chest X-ray – child with a tumour in the left ventricle and pericardial effusion

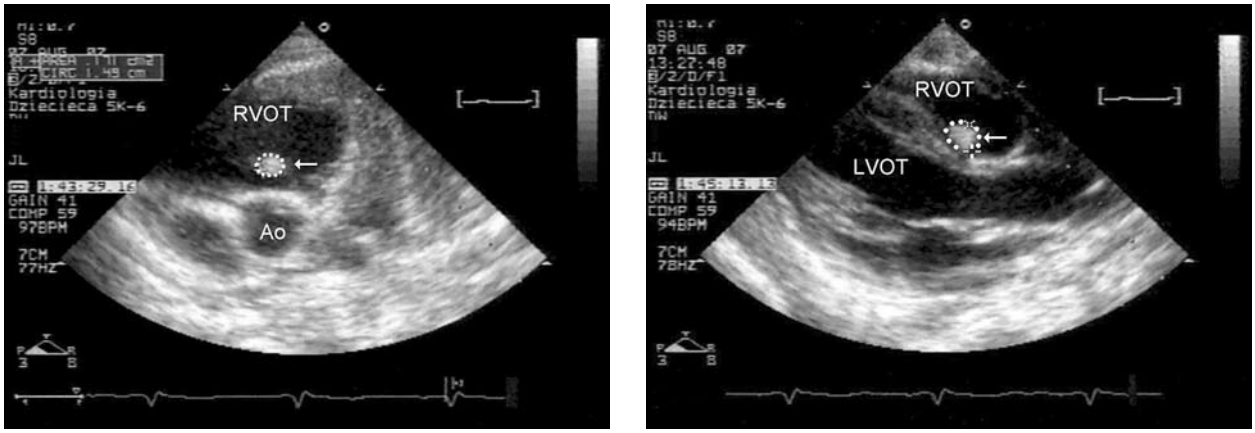

Figure 6. Chest X-ray – child with a tumour in the left ventricle and pericardial effusion
Ao – aorta, RVOT – right ventricular outflow tract, LVOT – left ventricular outflow tract

most common cardiac neoplasm in paediatric population [7, 8]. It may originate in different parts of the heart. However, if it is located in the right heart (as in case 7), it often leads to right-sided failure symptoms. Unlike in the case of rhabdomyomas, spontaneous regression of fibroma has not been reported. Therefore, it is usually advisable (if feasible) to excise the tumour as early as possible, because of its tendency to grow fast and cause severe hemodynamic complications [7, 8].

The fourth most frequent type of primary tumours in children is teratoma. It used to be associated with high mortality. However, thanks to early diagnosis and better surgical methods the survival rate in this condition has increased. Case 8 corroborates the data found in the literature. Teratoma is usually single and may reach a considerable size, sometimes even larger than an infant's heart. It is usually located in the pericardium (it is rarely intracardiac) and causes pericardial effusion. In infants it is usually situated between the aorta and the superior caval vein. In 2 out of 3 infants, this type of tumoral tissue presents with symptoms of compression of the main vessels of the heart, pulmonary compression and/or severe cardiac tamponade, as well as sudden death. Prenatal diagnosis is essential since it enables early treatment and prevents the development of the dangerous complications enumerated above [7, 14, 15].

In our study (among histopathologically confirmed cases) there were no cases of myxoma, which account for 10-15% of all cardiac tumours in children. It is considered to be the third most common neoplasm in the paediatric population after rhabdomyoma and fibroma.

Conclusions

Cardiac tumours in children are rare. The most commonly encountered tumour is rhabdomyoma, which has a tendency to diminish or even disappear completely. Each patient with rhabdomyoma requires careful neurological observation. Cardiosurgical treatment is advisable when a cardiac tumour creates life-threatening hemodynamic disorders or/and arrhythmias.

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Rozpoznanie, przebieg kliniczny i obserwacja kliniczna dzieci z guzami serca – doświadczenia własne

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Streszczenie

Wstęp: Guzy serca dzieli się na pierwotne i wtórne (przerzutowe). Większość pierwotnych guzów serca u dzieci występuje w postaci łagodnej (ok. 90%), a zagrożenie poważną chorobą wiąże się z lokalizacją zmian. Złośliwe guzy pierwotne to najczęściej mięsaki naczyniowe (*angiosarcoma*), włókniakomięsaki (*fibrosarcoma*), mięsaki limfatyczne (*limphosarcoma*) oraz mięsaki wielkokomórkowe (*giant cell sarcoma*). Guzy wtórne (występujące zwykle jednocześnie w miokardium i perikardium) stwierdza się częściej niż pierwotne. Najczęstsze wtórne guzy serca u dzieci to chłoniaki nieziarnicze, nacieki białaczkowe i *neuroblastoma*. Opisywane są też guzy Wilmsa rozciągające się z żyły głównej dolnej do prawego przedsionka serca, a nawet przechodzące przez zastawkę trójdzielną do światła prawej komory. Częstość stwierdzania poszczególnych typów histologicznych guzów serca zależy od wieku badanej populacji. U dorosłych ogromną większość stanowią śluzaki (*myxoma*), w populacji dziecięcej natomiast najczęściej opisywanymi guzami serca są mięśniaki (*rhabdomyoma*), stanowiące około 50% wszystkich nowotworów serca u dzieci. Kolejne miejsca pod względem częstości występowania zajmują: włókniaki (*fibroma*), śluzaki, potworniaki (*teratoma*) i naczyniaki (*haemangioma*).

Cel: Analiza objawów klinicznych, rozpoznania oraz dalszych losów dzieci z guzami serca rozpoznanymi w Klinice Kardiologii Dziecięcej w latach 1993–2008.

Metody: W retrospektywnej analizie 15-letniego materiału klinicznego odnaleziono 9 dzieci z guzami serca, potwierdzonymi ultrasonograficznie u wszystkich oraz patomorfologicznie w 5 przypadkach.

Wyniki: Rozpoznanie postawiono u 6 chłopców i 3 dziewczynek, w większości w wieku niemowlęcym. U większości (4 dzieci) podstawowym objawem był szmer nad sercem. Dwoje dzieci nie miało objawów, a u pozostałych stwierdzono niewydolność krążenia (2 dzieci) lub zaburzenia rytmu serca (1 dziecko). Pięcioro dzieci poddano operacji usunięcia guza(ów): 3 przypadki mięśniaków, 1 włókniak i 1 potworniak. U 3 nieoperowanych dzieci rozpoznanie mięśniaka było najbardziej prawdopodobne. Obserwacja długoterminowa (możliwa u 8/9 dzieci) wykazała prawidłowy rozwój 6 dzieci. U pozostałych 2 dzieci pojawiły się objawy neurologiczne.

Wnioski: W prezentowanym materiale pierwotne guzy serca u dzieci najczęściej powodowały szmer lub niewydolność krążenia. Większość dzieci wymagała leczenia operacyjnego. W badaniu patomorfologicznym wykazano, że większość guzów stanowiły mięśniaki. Obserwacja długoterminowa wykazała prawidłowy rozwój u 6 na 9 dzieci.

Słowa kluczowe: guzy serca, diagnoza, dzieci

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