CHAPTER 4

Prenatal Detection of Transposition of the Great Arteries reduces Mortality and Morbidity


Ultrasound in O&G 2015 Mar 45;320-5
ABSTRACT

Objectives
To evaluate the prenatal detection of transposition of the great arteries (TGA), after the introduction of a Dutch screening program in 2007, as well as the effect of prenatal detection on pre- and postsurgical mortality and morbidity.

Methods
In a geographical cohort study, all infants with TGA who were born between 1 January 2002 and 1 January 2012 were included. The cases were divided into two groups: those with and those without a prenatal diagnosis. Pre- and postsurgical mortality was assessed, with a follow-up of 1 year. Pre-surgical morbidity was assessed in terms of cardiovascular compromise, metabolic acidosis, renal and/or hepatic dysfunction and closure of the duct before initiation of therapy.

Results
Of all cases (n=144), 26.4% were diagnosed prenatally, with detection rates of 15.7% and 41.0% in the first and last 5 years of the study period, respectively. First-year mortality was significantly lower in cases with a prenatal diagnosis of TGA than in those without (0.0% vs 11.4%, respectively). Pre-surgical mortality (4.9%) only occurred in undetected simple TGA cases. Closure of the duct before treatment, renal dysfunction and hypoxia occurred significantly more often in the group without a prenatal diagnosis.

Conclusions
The prenatal detection rate of TGA has increased significantly since the introduction of the screening program in 2007. Prenatal diagnosis is an important factor that contributes to survival of the infant in the first postnatal year. Furthermore, some morbidity indicators were significantly higher in the group without a prenatal diagnosis. These results justify efforts to improve prenatal screening programs.
INTRODUCTION

Transposition of the great arteries (TGA) is one of the most common cyanotic congenital heart defects (CHD), with an incidence of 0.2–0.3 per 1000 live births. 1,2 TGA with an intact ventricular septum or a non-significant ventricular septal defect (VSD), also defined as simple TGA, is rarely associated with chromosomal or extracardiac anomalies. 2 The condition is generally well tolerated by the fetus, but life-threatening cyanotic complications occur shortly after birth. Without treatment, 50% of these infants die within the first month and 90% within the first year of postnatal life. 3 Directly after birth, prostaglandin-E1 is administered to keep the ductus arteriosus open to allow for the mixing of oxygen-rich and oxygen-poor blood. If necessary, a Rashkind procedure (atrial septostomy) is an additional measure that can be performed for short-term survival. The arterial switch operation (ASO) restores a normal pulmonary and systemic circulation, with a 20-year survival rate of 97% and a low surgical mortality rate of 2–5%. 4–6 The preoperative mortality rate is, however, around 4–6%. 6,7 The prenatal detection rate of simple TGA is low (3–27%). 8–12 Gardiner et al. 13 recently published data on an improved detection rate of 37% in a geographically discrete region with local training programs. It is essential that the outflow-tract and three-vessel views are included in screening protocols, as simple TGA shows a normal four-chamber view. 14,15 When the standard anomaly scan was introduced into practice in The Netherlands in January 2007, the four-chamber and outflow-tract views were obligatory items in the protocol. The three-vessel view was a recommended item, but was not compulsory until January 2012. 16 Without a prenatal diagnosis, most infants with TGA are born outside of tertiary-care centers, which delays appropriate care. This may result in unnecessary death or multi-organ or neurocognitive damage. The prenatal diagnosis of TGA reduces neonatal mortality. 7,8,17,18 It is difficult to ascertain whether a prenatal diagnosis influences morbidity, as only a few cohort studies on this subject have been published. Although a positive effect has been observed in some studies 7,17,19, this has not been replicated in others. 5,20

The aim of this study was to determine the prenatal detection rate of TGA in a national screening program and to evaluate the effect of prenatal detection on pre- and postsurgical mortality and pre-surgical morbidity.

METHODS

This was a cohort study in an unselected population, conducted in the north-west region of The Netherlands. Three tertiary referral centers – Academic Medical Center (Amsterdam), VU Medical Center (Amsterdam) and Leiden University Medical Center (Leiden) – are responsible for the care of children with CHD in this region. Cases with TGA
diagnosed both pre- and postnatally between 1 January 2002 and 1 January 2012 in the referral region of the centers were identified. Prenatal screening in The Netherlands is mostly performed in primary and secondary healthcare centers; when an anomaly is suspected, patients are referred to tertiary centers. In the obstetric departments of the tertiary centers, fetal echocardiography is performed by a perinatologist in collaboration with a pediatric cardiologist. All cases of suspected fetal TGA were identified from the prenatal ultrasound databases of the tertiary centers. The case list was complemented with all infants with TGA that was diagnosed after birth, selected from the pediatric cardiology departmental databases and cross-checked with catheterization schedules, operating schedules and emergency admissions. To identify infants who had died outside a hospital or who were dead on arrival at an emergency room, postmortem reports from pathology departments were studied. Finally, the database of the Dutch sudden infant death syndrome registry was searched for all cardiac cases that may not have been recorded in the hospital databases. All the cases were reviewed and the pre- and postnatal data were matched. To define a uniform cohort, we included cases of TGA with intact ventricular septum or TGA with VSD with or without coarctation of the aorta (CoA) and/or Taussig–Bing syndrome. Early management of these groups of patients is similar and an arterial switch is the major surgical repair required, with the addition of VSD closure or coarctectomy if needed. We excluded cases with double discordance, atrial isomerism, significant pulmonary stenosis, double outlet right ventricle with the pulmonary artery arising more than 50% from the right ventricle and univentricular heart defects, because all these defects require a different surgical approach.

We compared cases with a prenatal diagnosis to those without. All analyses were performed separately in the group of simple TGA (TGA with intact ventricular septum or TGA with non-significant VSD), since this is a homogeneous group, the pathophysiology of which requires urgent treatment in the first week after birth.

**Data collection and treatment**

Data concerning the mother, pregnancy, birth and infant were collected from medical files and included: prenatal ultrasound anomalies and diagnosis, pregnancy outcome, gestational age at delivery, birth weight, sex, location of delivery, age at postnatal diagnosis, presence or absence of extracardiac anomalies, aneuploidy or a genetic syndrome and postpartum diagnosis by echocardiography or, when applicable, results of postmortem examination.

All prenatally diagnosed patients were born in one of the three tertiary centers and admitted to the neonatal intensive care unit for prostaglandin infusion immediately after birth. Additional medication or ventilation was started when indicated. The pediatric cardiologist examined the patient after birth, performed an echocardiogram to make a
definitive diagnosis and evaluated the need for a Rashkind procedure. In cases without a prenatal diagnosis, the infants were treated similarly, depending on their condition at the time of admission. We retrieved the following data from their medical files: necessity for resuscitation with inotropes presurgery, oxygen saturation at admission, lowest pH and lactate presurgery (after first pH and lactate directly after birth), levels of creatinine, urea, aspartate aminotransferase and alanine aminotransferase measured no later than day 3 after birth or at admission, closure of the arterial duct before initiation of prostaglandin therapy and performance of a Rashkind procedure. Renal dysfunction was defined as a creatinine level >100 μmol/L (or >60 μmol/L if >7 days old) or urea level >7.0 mmol/L. Furthermore, the number of surgical interventions the infant underwent in the first year following birth and their pre- or postoperative mortality were recorded. Follow-up of all cases was for at least 1 year.

**Statistical analysis**

Means and SD were calculated to describe numeric variables and Student’s t-test was used to study the differences between the prenatal- and the postnatal-diagnosis groups. Frequencies and percentages were used to describe categorical variables and the chi-square test was used to test associations between categorical variables. For the rates of first-year mortality and closure of the arterial duct before initiation of prostaglandin therapy a likelihood ratio test was used, providing a robust test when frequencies were less than five. We considered P <0.05 to be statistically significant; all tests were two-sided. Data analysis was performed with the SPSS software package version 20 (SPSS Inc., Chicago, IL, USA).

**RESULTS**

**Inclusions, prenatal detection and pregnancy outcome**

We identified 144 cases with TGA. The total birth rate (including stillbirth and termination of pregnancy) in this 10-year study period in the same region was 724 089 births (data supplied by Statistics Netherlands, CBS, Geboorte, kerncijfers, StatLine, Central Bureau of Statistics (accessed 10 December 2012)), resulting in a total birth prevalence for TGA of 2.0 per 10 000 births. Simple TGA occurred in 105 cases, TGA with VSD with or without CoA and/or Taussig–Bing syndrome in 39 cases. There was a significant increase in the proportion of cases diagnosed prenatally as the study progressed. In the period between 2002 and 2006, 13 (15.7%) of the 83 cases with TGA were detected prenatally compared with 25 (41.0%) of the 61 cases in the period between 2007 and 2011, a difference of 25.3% (95% CI, 10.7–39.9%) (P=0.001) in the prenatal detection rate of TGA between these periods. The prenatal detection rate for simple TGA increased from 12.9% (8/62)
between 2002 and 2006 to 44.2% (19/43) between 2007 and 2011, a difference of 31.3% (95% CI, 14.4–48.3%) (P <0.001). This increase in prenatal detection corresponded with the initiation of the nationwide prenatal screening program in 2007. Figure 1 shows the percentage of TGA cases that were diagnosed prenatally between 2002 and 2011, according to year.

Gestational age at delivery and birth weight were similar for the groups with and without a prenatal diagnosis: mean 275 vs 278 days (P=0.186) and 3323 g vs 3446 g (P=0.207), respectively.

**Figure 1** Percentage of neonatal cases of transposition of the great arteries that were diagnosed prenatally in 2002–2011 in the north-west region of The Netherlands, according to year (n=144).
Severe extracardiac anomalies in combination with chromosomal or genetic defects were found in four cases (2.8%), of which three were cases of TGA with significant VSD or Taussig–Bing syndrome (pulmonary artery arising <50% from the right ventricle). In two of these cases, the pregnancy was terminated before 24 weeks’ gestation, and one was liveborn. In one case with simple TGA, 18p-syndrome was diagnosed after birth. All four cases were excluded from further analysis because of the severe extracardiac congenital anomalies and subsequent complications that affected postnatal outcome. One intra-uterine fetal death occurred in a case with simple TGA owing to an intrauterine infection diagnosed postmortem. A summary of the included cases, pregnancy outcomes and mortality is given in Figure 2. The distribution of cases within the cohort of 139 liveborn infants (without severe extracardiac anomalies) according to the subcategory of TGA and prenatal or postnatal detection is shown in Table 1. The mean age at diagnosis in the group without a prenatal diagnosis was 7.7 days, 61% were diagnosed within 5 days, 20% were diagnosed more than 10 days and 13% were diagnosed more than 20 days after birth. One case with a prenatal diagnosis was lost to follow-up, since the parents and infant moved out of the study region.

Figure 2 Flowchart summarizing inclusions, pregnancy outcomes and deaths of 144 cases of transposition of the great arteries (TGA) diagnosed in the north-west region of The Netherlands in 2002–2011.
Mortality
The presurgical mortality rate of all liveborn infants with simple TGA was 4.9%. None of the cases with a prenatal diagnosis died before surgery. Moreover, none of the cases with complex TGA died before surgery. Five infants (4.9%) of the 103 with simple TGA, born at home or in local hospitals, died before surgery could be performed; all five were of the 77 cases that did not have a prenatal diagnosis (6.5%). These deaths were distributed equally over the study period (2002–2011). One of them died suddenly at home the day after birth, two of them presented the day after birth at a local hospital requiring immediate resuscitation and died with multi-organ failure; the diagnosis of TGA was made at postmortem examination. The fourth case presented 1 hour after birth in a regional hospital with severe hypoxia, due to a severely restricted foramen ovale. Because the neonate showed severe cerebral damage and a therapy-resistant status epilepticus, ASO was not initiated and the neonate subsequently died several days later. The last neonate that died before surgery presented 13 days after birth requiring resuscitation, and died the same day with multi-organ failure.

Of the 133 infants who were operated on, seven (5.3%) died within the first year after surgery (Figure 2). Four of the deaths postsurgery were due to circulatory failure within 30 days after ASO. Another case died after several re-interventions, 4.5 months after ASO, resulting in a first-year mortality rate after ASO of 3.8% (5/131). Two other deaths were related to late presentation with simple TGA (age at diagnosis 21 and 24 days, respectively). A first-stage preparatory operation (pulmonary artery banding with a Blalock–Taussig shunt) was performed. Both infants died before an ASO could be performed. All postoperative deaths occurred in patients without a prenatal diagnosis in the years 2002–2007.

Thus, the overall first-year mortality rate of liveborn infants with a prenatal diagnosis was 0/34 (0.0%) vs 12/105 (11.4%) infants with a postnatal diagnosis, a difference of 11.4% (95% CI, 5.3–17.5%), likelihood ratio =0.009.

Morbidity
The frequency of all indicators of presurgical morbidity is shown in Table 2. The group without a prenatal diagnosis had a significantly higher incidence of hypoxia, renal dysfunction and closure of the arterial duct before initiation of prostaglandin treatment than did the group with a prenatal diagnosis. For most variables, the data were >95% complete. However, blood analysis of hepatic function was not performed in a considerable number of infants (40%), especially in the group with a prenatal diagnosis (79% not performed).

There was no significant relationship between the age (days) at postnatal diagnosis and the morbidity variables. Fifteen infants required more than one surgical intervention in
Table 1 The distribution of cases within the cohort of 139 live-born infants without severe extracardiac anomalies according to the subcategory of transposition of the great arteries (TGA) and prenatal or postnatal detection

<table>
<thead>
<tr>
<th>TGA subtype</th>
<th>Prenatal diagnosis</th>
<th>Postnatal diagnosis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple TGA</td>
<td>26 (25.2)</td>
<td>77 (74.8)</td>
<td>103 (74.1)</td>
</tr>
<tr>
<td>TGA with significant VSD</td>
<td>4 (17.4)</td>
<td>19 (82.6)</td>
<td>23 (16.5)</td>
</tr>
<tr>
<td>+CoA</td>
<td>1 (16.7)</td>
<td>5 (83.3)</td>
<td>6 (4.3)</td>
</tr>
<tr>
<td>TGA Taussig-Bing</td>
<td>4 (30.8)</td>
<td>9 (69.2)</td>
<td>13 (9.4)</td>
</tr>
<tr>
<td>+CoA</td>
<td>2 (33.3)</td>
<td>4 (66.7)</td>
<td>6 (4.3)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>34 (24.5)</td>
<td>105 (75.5)</td>
<td>139</td>
</tr>
</tbody>
</table>

Data is given as n (%). CoA, coarctation of the arteries; VSD, ventricular septal defect.

Table 2 Frequency and outcome of indicators of presurgical morbidity in 139 infants with transposition of the great arteries (TGA) between 2002 and 2012

<table>
<thead>
<tr>
<th>Clinical characteristic</th>
<th>Category of TGA</th>
<th>With prenatal diagnosis (n=34)</th>
<th>Without prenatal diagnosis (n=105)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest pH pre-surgery</td>
<td>All</td>
<td>7.20 (0.15)</td>
<td>7.24 (0.12)</td>
<td>0.088</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>7.19 (0.16)</td>
<td>7.24 (0.14)</td>
<td>0.113</td>
</tr>
<tr>
<td>Highest lactate pre-surgery</td>
<td>All</td>
<td>4.75 (2.45)</td>
<td>4.97 (4.82)</td>
<td>0.807</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>4.82 (2.66)</td>
<td>5.44 (5.46)</td>
<td>0.589</td>
</tr>
<tr>
<td>Oxygen saturation at admission †</td>
<td>All</td>
<td>73.6 (15.9)</td>
<td>67.0 (15.55)</td>
<td>0.048*</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>69.4 (15.6)</td>
<td>63.3 (15.1)</td>
<td>0.099</td>
</tr>
<tr>
<td>Renal dysfunction †</td>
<td>All</td>
<td>1 (4.3%)</td>
<td>17 (19.1%)</td>
<td>0.039*</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>1 (5.6%)</td>
<td>15 (21.7%)</td>
<td>0.021*</td>
</tr>
<tr>
<td>AST ‡</td>
<td>All</td>
<td>60.9 (23.9)</td>
<td>204.5 (941.5)</td>
<td>0.633</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>59.3 (26.1)</td>
<td>256.0 (1085.0)</td>
<td>0.613</td>
</tr>
<tr>
<td>ALT ‡</td>
<td>All</td>
<td>38.7 (29.5)</td>
<td>90.2 (489.6)</td>
<td>0.730</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>32.4 (18.3)</td>
<td>112.6 (561.9)</td>
<td>0.673</td>
</tr>
<tr>
<td>Closure duct before start PGE †</td>
<td>All</td>
<td>-</td>
<td>21 (23.6%)</td>
<td>0.000*</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>-</td>
<td>13 (19.7%)</td>
<td>0.002*</td>
</tr>
<tr>
<td>Inotropes pre-surgery</td>
<td>All</td>
<td>7 (21.2%)</td>
<td>27 26.0%)</td>
<td>0.602</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>7 (28.0%)</td>
<td>22 (28.6%)</td>
<td>0.712</td>
</tr>
<tr>
<td>Rashkind performed</td>
<td>All</td>
<td>20 (60.6%)</td>
<td>67 (64.4%)</td>
<td>0.691</td>
</tr>
<tr>
<td></td>
<td>Simple</td>
<td>17 (68.0%)</td>
<td>57 (74.0%)</td>
<td>0.557</td>
</tr>
</tbody>
</table>

Data are given as mean plus or minus SD or n/N (%).
All TGA (n=139) includes simple TGA (n=103) and TGA with ventricular septal defect or Taussig–Bing syndrome, with or without coarctation of the aorta (n=26).
26 cases of simple TGA had a prenatal diagnosis; 77 had a postnatal diagnosis.
Missing data <4% for most variables. *P <0.05.
†15% missing data.
‡40% missing data (missing in 79% of cases with prenatal diagnosis; tests were performed only on indication). ALT, alanine aminotransferase; AST, aspartate aminotransferase; PGE, prostaglandin-E.
the first year after birth. In five of these cases, a two-stage ASO was performed (three owing to late postnatal diagnosis (>21 days after birth), one owing to premature closure of the foramen ovale and one because of a pulmonary hemorrhage). All other cases (n=10) required re-interventions after ASO owing to postsurgical residual defects. Two or more surgical interventions tended to be needed more frequently in the group without a prenatal diagnosis than in those with a prenatal diagnosis: 12.4% vs 0.6% (P=0.089), respectively. Severe neurological complications in the first year after birth occurred in two cases, of which one died (described previously). The other case was diagnosed 1 day after birth with simple TGA and suffered cerebral infarctions and subdural hemorrhage.

DISCUSSION

This paper describes the largest population-based cohort study of neonates with TGA performed to date, assessing prenatal detection and mortality and morbidity rates in the first year after birth. The total birth prevalence of TGA was 2.0 per 10 000 births, which is in accordance with data in the published literature.\(^2,8\) We found that a prenatal diagnosis of TGA is associated with a first-year mortality rate of 0%. Moreover, this study evaluated multiple objective indicators of the severity of the illness preoperatively and found that several indicators were significantly in favor of the group with a prenatal diagnosis. The prenatal detection rate of TGA and especially simple TGA increased significantly from 15.7% to 41.0% and from 12.9% to 44.2%, respectively, after a national screening program was introduced in 2007. It is known that the prenatal detection rate of TGA and especially simple TGA is generally low (<27%).\(^8,12\) The improvement in prenatal detection in The Netherlands can be attributed to the introduction of a uniform national screening protocol with trained and certified ultrasonographers. In contrast to other CHD, simple TGA has a low prevalence of associated malformations and genetic or chromosomal anomalies likely to influence the outcome. Postnatal survival in newborns with TGA largely depends on the timely initiation of specific treatment after birth.\(^21\) As the surgical results for ASO continue to improve and operative mortality falls below 3%\(^4\), strategies to optimize neonatal presurgical care are essential to reduce the overall mortality rate of TGA and especially simple TGA. Significant decreases in mortality rate have been shown after a prenatal diagnosis.\(^7,8,17,18\) Bonnet et al.\(^7\) described a significant decrease in mortality rate, down to 0% after a prenatal diagnosis. The data they used for their study were from 1988–1997 and were institution-based, which means that only infants referred to their center were included. Since the 1990s, the performance of prenatal screening has improved significantly.\(^18\) More recent population-based studies have also shown a reduced mortality rate in prenatally diagnosed infants, but the
number of cases was rather limited. 8,17,18 Our findings confirm that even in the present era, with modern resuscitation techniques, a prenatal diagnosis is important in order to reduce overall mortality. The first-year mortality rate of liveborn infants with a prenatal diagnosis was 0.0%, compared with 11.4% for infants without a prenatal diagnosis. Presurgical mortality of the simple TGA cases without a prenatal diagnosis was 6.5%. These deaths were equally distributed over the 10-year study period, which rules out a bias due to improved resuscitation and intensive care. The postsurgical deaths all occurred in the first 6 years of the study period. This might be explained by the progress in pediatric diagnostics, pediatric cardiology, cardiac surgery and intensive care in the most recent years. Differences in morbidity within the first year after birth are more complex to evaluate, since morbidity is difficult to capture as a single outcome variable. Bonnet et al. 7 found a significantly higher rate of preoperative mechanical ventilation and metabolic acidosis as well as a significantly longer hospital stay in the group without a prenatal diagnosis. Fuchs et al. 17 found some indicators of morbidity to be significantly in favor of cases with a prenatal diagnosis, however four different cardiac diseases were analyzed as one cohort, without a separate analysis for TGA. Children and adolescents born with TGA have higher rates of neurodevelopmental problems after correction of TGA than do normal populations. 22,23 The main explanation for this is the hypoxic complications that occur before and during surgery. 24 Calderon et al. 19 described better neurocognitive outcomes in children with a prenatal diagnosis. This was attributed to immediate and optimal presurgical care. Since follow-up in our study was for only 1 year after birth, it is not possible to report the long-term neurological follow-up.

We found a significantly higher incidence of preoperative hypoxia, closure of the arterial duct before initiation of prostaglandin treatment and renal dysfunction in those infants without a prenatal diagnosis. Although not statistically significant, two or more surgical interventions were needed more frequently in the group without a prenatal diagnosis. In some cases multiple interventions could have been prevented by a prenatal diagnosis. All these adverse outcomes could contribute to long-term neurodevelopmental problems.

All analyses were performed separately in the simple TGA cases. The main argument for performing a separate analysis is the homogeneity of this group, which is not influenced by more complex surgical anatomy, allowing for the most reliable assessment of the effects of prenatal diagnosis. Moreover, this particular group has the most urgent pathophysiology in the first week after birth. We found a significantly higher incidence of closure of the duct before initiation of treatment and of renal dysfunction in the group without a prenatal diagnosis. Although not statistically significant, the rates of hepatic dysfunction and high lactate levels tended to be higher in the group without
a prenatal diagnosis. The blood analysis of hepatic function was not performed during admission in a considerable number of infants (40%), especially in the group with a prenatal diagnosis (79% not performed), possibly indicating that the clinical condition of infants with a prenatal diagnosis was more favorable. This was a population-based study in an area where 72,000 infants are born per year, which is approximately 40% of all live births in The Netherlands. All cases in the region were included, from rural as well as urban areas, including deaths outside the hospital.

The lost-to-follow-up rate in our cohort was very low. Another strength of this study is that the implementation of the screening program and the training and certification of ultrasonographers have been uniform throughout The Netherlands. Even though this is one of the largest cohorts analyzed, this study is nevertheless limited by the number of cases included and its retrospective character.

The detection rate of TGA has improved significantly since 2007, however, over 50% of cases of TGA are still being missed by prenatal screening. The three-vessel view has been included as a compulsory element in the prenatal cardiac screening protocol since January 2012.

With education for ultrasonographers on how to evaluate the three-vessel view plane and the spatial relationship between the aorta and pulmonary trunk, an improved performance of screening for TGA can, we hope, be achieved.

In conclusion, first-year and presurgical mortality rates of cases with TGA are significantly decreased by a prenatal diagnosis, from 11.4% to 0% and from 4.9% to 0%, respectively. Moreover, several presurgical morbidity indicators are significantly in favor of the group with a prenatal diagnosis, indicating that these infants are in a better condition presurgery. Still, a substantial number of infants with TGA are diagnosed days to weeks after birth. These results justify all efforts to improve prenatal screening programs.
REFERENCES


(5) Kumar RK, Newburger JW, Gauvreau K, Kamenir SA, Hornberger LK. Comparison of outcome when hypoplastic left heart syndrome and transposition of the great arteries are diagnosed prenatally versus when diagnosis of these two conditions is made only postnatally. Am J Cardiol 1999; 83: 1649–1653.


