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Tanısal anjiyokardiyografide kullanılan radyokontrast maddenin QT ve QTc Dispersiyonlarına Etkisi

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ÖZET

Aritmi kardiyak kateterizasyonun geçici komplikasyonlarından biridir. Koroner anjiografi esnasında ventriküler fibrilasyon görülme ihtimali düşüktür. QT ve düzeltilmiş QT (QTc) dispersiyonları aritmiye yatkınlığı göstermektedir. Konjenital kalp hastalığı olan çocuklarda tanısal anjiyokardiyografide kullanılan radyokontrast maddenin QT ve QTc dispersiyonlarına etkisini araştırmak amacıyla bu çalışma yapılmıştır. Kliniğimizde tanısal anjiyokardiyografi yapılan 40 hasta (18 kız, 22 erkek) çalışmaya dahil edildi. Tanısal anjiyokardiyografi öncesinde ve sonrasında çekilen 12 kanallı elektrokardiyografilerden QT ve QTc süreleri hesaplandı. Çalışmaya alınan hastaların yaşları 4 ay-14.4 yıl (ortanca 61 ay) arasında değişmekteydi. Tanısal anjiyokardiyografi esnasında bir olguda supraventriküler taşikardi, bir olguda sürekli ve bir olguda da süreksiz ventriküler taşikardi gelişti. Supraventriküler taşikardi adenozin tedavisi ile kontrol altına alınırken, ventriküler taşikardiler kendiliğinden düzeldi. Anjiyokardiyografi esnasında kullanılan ortalama non-iyonik radyokontrast madde miktarı 4.36±1.39 ml/kg idi. Hastaların anjiyokardiyografi öncesi ve sonrası QT ve QTc dispersiyonları arasında farklılık saptanmadı. Tanısal anjyokardiyografi de kullanılan non-iyonik radyokontrast maddelerin QT ve QTc dispersiyonlarını etkilemediği görülmüştür. Bu sonuç çocuklarda tanısal anjiyokardiyografi sırasında görülen aritmilerin çoğunlukla geçici olduğunu ve kardiyak iskemi ile ilişkili olmadığını düşündürmektedir.
Anahtar kelimeler: Çocuklar; tanısal anjiyokardiyografi; radyokontrast; QT and QTc dispersiyonları.

Impact of radiocontrast media on QT and QTc dispersions in children with congenital heart disease

ABSTRACT

Arrhythmia is one of the transient cardiac catheterization complications. The injection of radiocontrast media into coronary arteries may produce a low incidence of ventricular fibrillation. It is known that QT and corrected QT dispersions show predisposition to arrhythmias. We have evaluated the effect of radiocontrast after diagnostic angiocardiography on QT and QTc dispersions in children with congenital heart disease. Forty patients (18 girls and 22 boys) with congenital heart disease, who were performed cardiac catheterization at our institute, were included into the study. The QT and QTc durations were calculated manually from 12-lead electrocardiography before and after angiocardiography. Ages of the study population varied between 4 months and 14.4 years (median age was 61 months). Arrhythmias (supraventricular tachycardia, sustained ventricular tachycardia and non-sustained ventricular tachycardia) were determined in three patients. The mean amount of radiocontrast media expended during angiocardiography was 4.36±1.39 ml/kg. QT and QTc dispersions showed no significant changes after diagnostic angiocardiography, although exposure to radiocontrast media was present. Arrhythmias which occur during diagnostic angiocardiography in children, may be mostly transient. Because we didn't find any effect of radiocontrast on QT and QTc dispersions during diagnostic angiocardiography and arrhyhmias developed during angiocardiography were not persistent after the procedures.
Key words: Children; diagnostic angiocardiography; radiocontrast; QT and QTc dispersions.

INTRODUCTION

Arrhythmia is one of the transient complications of cardiac catheterizations (1,2). The incidence of arrhythmias seen in children during cardiac catheterization is 1.8-2.6% (2,3). Sinus bradycardia and tachycardia, supraventricular tachycardia (SVT), ventricular tachycardia (VT) and atrioventricular blocks are some examples of the arrhythmias occurring during cardiac catheterization. Most arrhythmias are associated with inadvertently probing or compressing on the myocardium or conduction tissue. Intracoronary injections may lead to arrhythmias and especially, ventricular fibrillation may develop during coronary angiography (4). During cardiac angiography, surface electrocardiographic change is common, predictable and dose-related adverse reactions to radiocontrast media. Some studies are reported that mostly, no changes of QTc occur because of radiocontrast media during left ventriculography in adults (5,6). In recent years, various

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radiocontrast media have been developed for use in diagnostic angiography in children.

QT dispersion, a known electrophysiological factor, creates tendency to ventricular arrhythmias and also sudden cardiac death (7,8). It shows the difference between repolarization durations among several electrocardiographic leads and reflects local differences in recovery time of the myocardium. Studies have shown that when the heart rate-corrected QT duration and dispersion are prolonged, ventricular arrhythmias may happen and also the risk of sudden death increases in a variety of diseases such as malignant ventricular arrhythmias, coronary heart disease, congestive heart failure, mitral valve prolapse, hypertension, diabetes mellitus and pulmonary hypertension (7-14).

The aim of this study is to evaluate the effects of radiocontrast media on QT and QTc dispersions during diagnostic cardiac catheterization in children with congenital heart disease.

MATERIALS AND METHODS

Diagnostic cardiac catheterizations were performed in forty patients (18 girls and 22 boys) with congenital heart disease at a university hospital between January 2010 and May 2010. For all patients, the following patient data were obtained; age, gender, weight and diagnosis Before catheterization, presence of arrhythmias, antiarrhythmic treatment, electrolyte imbalance and also pulmonary artery hypertension were the exclusion criteria for the study. The QT and QTc durations of all subjects were calculated manually from 12-lead resting electrocardiogram during sinus rhythm. A supine standard 12-lead electrocardiogram tracing at 25 mm/s paper speed and 10 mm/mV amplitude was used for the measurement of QT-interval before and after angiocardiography. QTc duration was calculated based on Bazett's Formula (15). QT and QTc measurements of all patients were taken manually by one cardiologist (ZK), blinded to the results of the angiocardiographies. QT duration was measured from the beginning of the QRS complex to the end of the T-wave where the terminal limb joined to the baseline. When T-wave deflections of equal or near-equal amplitude resulted in a diphasic T wave, the QT interval was measured to the time of final return to baseline. When a second low-amplitude repolarization wave interrupted the terminal portion of the T wave, it was difficult to determine whether the second deflection was a diphasic T wave or an early-occurring U wave. QT and QTc dispersions were calculated as the difference between maximum QT/QTc durations and minimum QT/QTc durations (QT dispersion: QTmax-QTmin, QTc dispersion: QTcmax-QTcmin). The arrhythmias were recorded during angiocardiographic processing.

During the cardiac catheterization, diagnosis and hemodynamic parameters were evaluated. The procedures were performed in fasting state after the patients were premedicated with chlorpromazine,

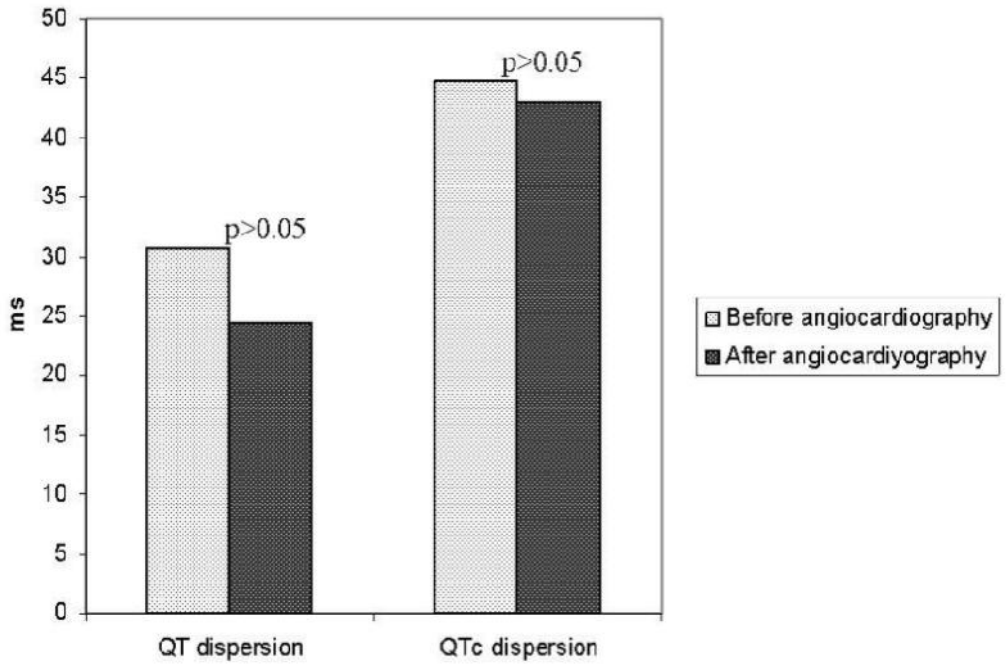

Figure 1. Comparison of QT and QTc dispersions before and after angiocardiographies

diazepam or midazolam. The catheters were introduced after proper femoral venous and/or arterial accesses were established. Iohexol (Omnipaque®) with the iodine concentration of 300 mg I/ml was used as contrast material in all subjects and 1.0-2.0 ml/kg contrast material was injected at a dose with the total dose not exceeding 6.0 ml/kg. A balloon catheter or a closed-end catheter with side holes was used for right heart, a pig-tail catheter was preferred for left-sided manipulations. All procedures were successfully completed. Patients were monitored after the procedure for 24 hours for signs of dysrhythmia.

The data were analyzed with SPSS-16 program. All values were expressed as mean ± standard deviation; median and range values were also provided for data with non-normal distribution. Comparison of the parameters, belonged to the different time periods (e.g., before and after angiocardiography), was performed with Paired-t test. P-value of less than 0.05 was considered to indicate statistical significance.

RESULTS

The age of the study population varied between 4 months to 14.4 years (median age was 61 months). Demographic characteristics and diagnosis of the patients are shown in Table 1. The mean amount of expended radiocontrast media was 4.36±1.39 ml/kg. QT dispersions in all patients before and after angiocardiography were 30.30±16.62 ms and 24.54±11.81 ms, and also QTc dispersions were 44.78±17.45 ms and 42.93±15.77 ms, respectively (Fig. 1). However, QTc dispersions were found longer than 50 ms in twelve patients (30%) before angiocardiography. Supraventricular tachycardia was detected in only one patient and sinus rhythm returned easily with 50 µg/kg adenosine administration. In two patients VT was detected and one of them continued (sustained) for a long period (>30 sec). Both children with VT recovered spontaneously without any treatment. Before angiocardiography, QT and QTc dispersions of these three patients were calculated as 27.31±5.2 ms (22-32) and 36.62±7.71 ms (28-43) respectively.

DISCUSSION

Increased QT dispersion is generally associated with heterogeneity of ventricular repolarization and has an important clinical correlation in patients with a wide range of heart

Table 1. Demographic characteristics and diagnosis of the patients

	Mean ± SD, Median (Interquartile Range) or %
Age	Median 61 months (4 months-14.4 years)
Sex (Female/Male)	18/22
Weight (kg)	18.12±10.19
Radiocontrast media (ml/kg)	4.36±1.39
Congenital heart disease (left-to-right shunt lesions)	23 (57.5%)
Congenital heart disease (left-to-right shunt lesions) and Pulmonary stenosis	6 (15%)
Tetralogy of Fallot	3 (7.5%)
Others	8 (20 %)

Others: Aortic stenosis, Congenital mitral stenosis, Double inlet left ventricle, Left pulmonary artey agenesis, Partial anomalous pulmonary venous return, Pseudocoarctation, Severe mitral regurgitation secondary to rheumatic carditis, Tricuspid atresia.

disorders (1,2,4,8). Increased QT dispersion is an important factor in the mechanisms underlying serious and fatal arrhythmias, particularly in the presence of cardiac ischemia (1,16). QT dispersion may be influenced by the extent of myocardial damage after myocardial infarction. In a patient with obstructed artery, successful thrombolysis was found to be associated with smaller infarct sizes and improved left ventricular function (17). An explanation for the observation of increased QT dispersion values in patients with larger infarcts could be the presence of larger amounts of fibrous tissue, which may influence the duration and homogeneity of repolarization (18). These data suggest that QT dispersion may be influenced by the extent of myocardial damage after myocardial infarction (17). In the literature, we did not find any studies related to the effects of radiocontrast media on QT dispersion in children with CHD during diagnostic cardiac catheterization, although studies especially related to coronary angiography and QT dispersion in adult patients with coronary artery disease, were abundant. QT dispersion in patients with coronary artery disease correlates with extent of ischemia and decreases after coronary angioplasty. QT dispersion significantly increases in the group of patients with documented restenosis and may be a simple non-invasive marker of restenosis (19-22). It has been shown that successful balloon angioplasty reduces the QT dispersion in patients with coronary artery disease (23). Also in another study, increased QT dispersion has been reported in patients with vasospastic angina. Increased QTc dispersion in asymptomatic patients with vasospastic angina was associated with increased vulnerability to ventricular arrhythmias related to ischemic events (24). Another study has been reported that serum elevations of cardiac troponin I and creatine kinase isoenzyme MB occur after the most of pediatric diagnostic cardiac catheterization procedures. It is apparent that myocardial injury, produced by cardiac catheterization and confirmed with serum elevations of cardiac troponin I and creatine kinase isoenzyme MB, was found more prominent in a certain group of pediatric patients (25). Transient ischemia may be seen during diagnostic cardiac catheterization. Diagnostic cardiac catheterization of children with congenital heart disease may cause myocardial injury and also arrhythmias. Typically, arrhythmias result from catheter impact on the myocardium and usually resolve with repositioning the catheter. In children with supraventricular tachycardia or atrial enlargement, attention should be paid to avoid stretching the atrium. Careful catheter manipulation, and in some lesions using tip-deflector wires or balloon-tipped catheters to diminish irritation of the myocardium, are helpful in avoiding arrhythmias (26). In our study, both of the QT and QTc dispersions were seperately similar between before and after angiocardiography. Our results may be due to non-coronary catheterizations of our patients. Additionally, we had no patient with coronary artery disease. In another study, following left coronary arteriography, diatrizoate caused a significant decrease in heart rate, prolongation of the QTc interval, and increase in T wave amplitude. In contrast, neither ioversol nor iopamidol caused significant changes in any electrocardiographic parameters. Adverse reactions were more common with diatrizoate than with either ioversol or iopamidol (27). In our study, nonionic iohexol was used and no significant changes of QT and QTc dispersions were detected.

Limitations

Effects of diagnostic cardiac catheterization of children with congenital heart disease on QT and QTc dispersions need further studies with more number of patients and also a variety of special group of diseases. Our sample size was small. Another limitation of our study was that, we used only Bazzett's Formula. Another method also can be used to measure QTc.

In conclusion, during diagnostic angiocardiography, no detrimental effects of nonionic radiocontrast media on QT and QTc dispersions were determined. Also, arrhythmias developed during diagnostic angiocardiography in children with congenital heart disease may be mostly transient.

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