International Journal of Contemporary Pediatrics
Baghel A et al. Int J Contemp Pediatr. 2019 May;6(3):1362-1366
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20192044

Original Research Article

Experience with Holter monitoring for evaluation of infant arrhythmia

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Received: 25 October 2018
Accepted:10 December 2018

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ABSTRACT

Background: Arrhythmia is defined as abnormal heart rates. Sometimes they are intermittent and difficult to diagnose on routine ECG. Neonatologist and Pediatrician needs to rapidly establish accurate diagnosis and management for infants suspected to have arrhythmia. Hence Holter monitoring of the infants presenting with symptoms suggestive of arrhythmia is necessary as it provides a continuous record of heart's electrical activity. The aim of this paper is to find out the role of continuous ambulatory electrocardiographic monitoring in daily clinical practice of Pediatrics.
Methods: All infants including neonates, either inborn or brought to the paediatric emergency with risk factors, between January 2016 to January 2018, were included in this prospectively study. Evaluation including chest X-ray, standard 12-lead electrocardiography, 24 hours continuous ECG monitoring using Mortara holter, echocardiography, biochemical and haematological analysis.
Results: A total of 73 babies were enrolled in present study. In this study arrhythmia was found in 29 (39.72%) new-borns. The most common arrhythmia observed was supraventricular tachycardia (SVT) (41.3%). Other arrhythmia observed were ventricular tachycardia (VT), AV block (34.4%), atria premature beats (3.4%) and ventricular premature beats (6.89%), tachy-bradyarrhythmia (3.4%) and junctional rhythm (3.4%). Of 29 arrhythmia patients four were diagnosed solely by Holter monitoring. None of the babies had long QT syndrome on Holter monitoring.
Conclusions: Cardiac arrhythmias are important causes of infant morbidity, and mortality if undiagnosed and untreated. It is important for the neonatologist and paediatrician to be aware of these of arrhythmias and the various diagnostic modalities available for them. A Holter electrocardiogram may be of value in identification of these transient arrhythmic events.

Keywords: Arrhythmia, Infant, Holter

INTRODUCTION

Arrhythmia is defined as deviation in heart rhythm from normal pattern. They may occur as a result of various cardiovascular, systemic and metabolic disorders. Arrhythmias are seldom observed in the infants and rarely lead to serious consequences. The incidence is about 1% during the neonatal period.[1] The actual incidence is probably higher, as large proportions of them are intermittent and resolve spontaneously. With the development of intensive care units and increased monitoring of patients, various rhythm alterations have been identified in neonates and infants considered healthy. The electrocardiogram (ECG) is the reference procedure to identify heart rhythm alterations; however, it is necessary to ascertain that an arrhythmia is not transitory. The majority of those arrhythmias are benign; a surface electrocardiogram is sufficient to establish a

diagnosis in most cases. A 24-hour (Holter) electrocardiogram recording can establish a diagnosis in patients with arrhythmias which cannot be documented with a surface electrocardiogram that who have transient rhythm alterations. AHA also recommends Holter monitoring for assessment of patients with high risk of arrhythmia.[2]

Arrhythmias in the neonatal stage entail high morbidity and mortality. Proper diagnosis and pharmacological control of rhythm offers a good long-term prognosis. It is important that doctors in charge of treating this group of patients recognize the causal factors of arrhythmias, and the diagnostic and therapeutic options available.

The aim of this paper was to show role of continuous electrocardiographic (twenty-four-hour ECG) monitoring in daily clinical Pediatric practice.

METHODS

This study included 73 infants and neonates (42 male, 31 female) who were suspected to have arrhythmia in a tertiary hospital between January 2016 to January 2018. In all cases sex, age, hematological and biochemical parameters were recorded. The detailed clinical examination and investigations were recorded on predesigned Performa. All 73 patients were subjected to 12 leads electrocardiography (ECG), 24-hour Holter ECG and echocardiography. Type, course of arrhythmia, detection time, treatment and outcome were analysed. The Holter recordings were done using portable battery-operated three-channel Holter recorder (Mortara recorder). The digitized three-channel ECG signals were processed by Holter analysis software and a dedicated algorithm converted the 24 hours recording into templates. For each template, an algorithm automatically measured the QT and the RR intervals (ms). The program provided the corrected QT intervals for heart rate according to the Bazett's formula (QTc). Number of premature beats in 24 hours was measured by counting them during every hour of recording and computing the total. They were classified according to the guidelines by AHA.[3] Recordings less than 20 hours due to lead displacement, loss of signal or artefact were not included. First parents were explained about Holter monitoring. There after an informed consent was obtained from parents.

Statistical analysis

The statistical analysis of the results was carried out using the Microsoft Excel 2010 (SPSS v20.0).

RESULTS

Total 73 infants were enrolled, of them 42 babies were male (68.2%) and 31 were female (31.8%).

The initial clinical presentations were poor feeding, irritability, respiratory difficulties, peripheral circulatory failure and cyanosis. The rhythm and conduction disorders were diagnosed in the 29 (39.72%) infants as shown in (Table 1).

Ten patients had bradyarrhythmia and fourteen had tachyarrhythmia and one had tachy bradyarrhythmia. Arrhythmia observed were Paroxysmal supraventricular tachycardia (PSVT), Supraventricular tachycardia (SVT), Ventricular tachycardia (VT), Atrioventricular block (AV block), atrial and ventricular premature beats, tachy bradyarrhythmia and junctional rhythm. Tachyarrhythmia is more common than bradyarrhythmia. Supraventricular tachycardia was the commonest arrhythmia observed in twelve babies (41.3%), followed by AV blocks in ten babies (34.4%). Other arrhythmias observed were premature ventricular contractions in two (6.89%), atrial premature beats in one (3.4%), tachy bradyarrhythmia in one case (3.4%), ventricular tachycardia in two (6.89%) and junctional rhythm in one (3.4%) cases (Table 1). None of the babies had long QT syndrome on Holter monitoring. Twelve babies had supraventricular tachycardia on Holter monitoring. One infant had two episodes of PSVT within a three months period. He was treated with adenosine and electric cardioversion and oral propranolol. Another baby had seven episodes of PSVT documented in 24 hours by Holter monitoring. Therapy with adenosine and amiodaron was begun and cardioversion was done. A re-entrant path was suspected, and he was referred to higher center for electric ablation.

There was one baby presented with excessive crying, decreased acceptance of feed and vomiting for two days. Her Holter recording revealed multiple episodes of PSVT which were refractory to adenosine, amiodarone infusion and cardioversion. Later flecainide was added. This association was successful in controlling the arrhythmia. She was having WPW syndrome.

PSVT are most common symptomatic arrhythmias among neonates that can be managed with drugs and patients recover uneventfully. In present study one newborn was admitted with sepsis developed supraventricular tachycardia. Antibiotic, supportive care, adenosine injection was given, and cardioversion was done but the tachycardia didn't resolve, and the baby succumbed within 24 hours due to primary illness. AVRT was in most of cases and in few cases of SVT it was not possible to give a more specific diagnosis from the clinical files, either because the arrhythmias were transitory or because they responded immediately to treatment. In present study, ten babies had heart block of them only one patient underwent pacemaker implantation. The only case of first-degree AV block occurred in a neonate was a temporary block. Most of the neonates did not need any kind of treatment.

Table 1: Distribution and clinical characteristics of the babies diagnosed with arrhythmia.

Type of arrhythmia	Total cases detected N=29	Diagnosed by ECG	Diagnosed by Holter	Arrhythmia associated with		Intervention	Outcome
				Normal heart	Congenital heart disease		
Supraventricular tachycardia (SVT)	2	2	0	0	2 (PDA, VSD)	Supportive treatment	One improved and one succumbed.
Paroxysmal supraventricular tachycardia (PSVT)	10	9	1	10	0	Iv adenosine, amiodarone in eight, Defibrillation in four, Flecainide in one baby.	All babies improved. Propranolol prophylaxis in two. Spontaneously resolved in two.
Atrial premature beats (APB)	1	1	0	1	0	Supportive treatment given	Disappear at 2 months.
Ventricular premature contractions (VPC)	2	1	1	1	1 (VSD with PFO)	Supportive treatment given.	Improved
Ventricular tachycardia (VT)	2	1	1	0	2 (Ebstien anomaly, complex CHD)	Supportive treatment	Both the babies expired.
AV Block	10	10	0	7	3 (ASD, VSD, Dilated cardiomyopathy)	Supportive treatment. Cardiac pacing done in one baby.	All babies were asymptomatic on discharge.
Tachy-brady syndrome	1	0	1	1	0	Cardiac pacing was done	Improved
Junctional rhythm	1	1	0	0	1 (ASD)	Symptomatic management	Referred to higher centre for corrective surgery

In present study two babies had premature ventricular contractions and one baby had premature atrial contractions at birth which disappeared on subsequent follow up. Junctional rhythm was detected in one neonate presented with hemodynamic instability. Epicardiac pacemaker was implanted to restore the sinus rhythm. Tachy bradyarrhythmia was detected in a 2-month baby presenting with sudden episode of cyanosis. Multiple electrocardiograms (ECG) were recorded which were normal since the episode was transient. Holter monitoring was done which revealed significant bradycardia during the episode. Of the 73 infants who were enrolled in the study, four (13.7%) infants demonstrated an arrhythmia only on Holter record. Mortality rate was 4.1%, corresponding to the primary illness. At hospital discharge, all the neonates presented hemodynamic stability.

DISCUSSION

Continuous electrocardiographic twenty-four-hour ECG monitoring is irreplaceable diagnostic method of arrhythmias. A Holter monitor may be needed to confirm the diagnosis as many of the arrhythmia in infants are benign or transient. In this paper, an attempt was made to show the value of 24 hours Holter monitoring in evaluation of the arrhythmia and its pattern in infants.

Authors found SVT (41.3%) is the most common sustained arrhythmia during the neonatal period and infancy. This result was compatible with the literature. However, this rate is higher than the SVT rate found in the study by Binnetoğlu FK et al, and Satar M et al.[4,5] Because of the paroxysmal nature of SVT, ECG findings may be normal, and further assessment should include a 24 or 48-hours evaluation with a Holter monitor. The 24 hours Holter monitoring demonstrated a higher prevalence of arrhythmia and also useful for detecting the underlying mechanism. AV nodal re-entrant tachycardia is rarely seen in the newborn and toddler periods.[4] In this period, AV re-entrant tachycardia is more frequent. In a study by Ko JK et al, only three of 137 (2.1%) had AV nodal re-entrant tachycardia.[6] No patient in present study had AV nodal re-entrant tachycardia. In our cases with

SVT, AV re-entrant tachycardia was the most frequent mechanism of tachycardia. According to Lupoglazoff JM et al, and Denjoy I et al, 70% of babies less than three months old with SVT have WPW pattern.[7] In a study by Gillijam T et al, the rate of WPW syndrome was 34%.[8] Kundak AA et al, studied 55 newborns; 22 had SVT and six had WPW syndrome.[9] In present study, one patient had WPW syndrome. Catheter ablation is an effective first-line treatment option for many patients with AVRT or AVNRT.[10] Inpresent study one baby was advised for catheter ablation.

Occasional premature beats are found only on 24-hour electrocardiographic recordings. Which are likely to be a normal feature of the newborn heart rhythm. In present study two babies had ventricular premature beats and one baby had supraventricular premature beats at birth which were benign and disappeared on subsequent follow up. Patients with ventricular premature beats did not have arrhythmia after the newborn period. In a study by Poddar B et al, premature beats lasted up to early childhood and spontaneously resolved without complications.[11] Binnetoğlu FK et al, found, 39.3% had supraventricular premature beats and 6% had ventricular premature beats.[4] Holter monitoring is necessary to determine an abnormality of sinus node function.[12] Congenital complete AV block had an observed rate of 1/15 000-20 000 for live births.[13] In present study ten babies had CHB on Holter recording, of them only one patient underwent pacemaker implantation. The only case of first-degree AV block occurred in a neonate was a temporary block. Most of the neonates did not need any kind of treatment. None of the babies had long QT syndrome on Holter recording. QT interval prolongation is associated with an increased risk of sudden death. Of the 73 infants who were enrolled in the study, only four babies had arrhythmia solely diagnosed on Holter recording. One case of each tachy bradyarrhythmia, PSVT, VT and ventricular premature beats were diagnosed by Holter. It is useful to detect transient and recurrent arrhythmias which were not detected by surface ECG. Authors had two infants with repeated episodes of supraventricular tachycardia on Holter monitoring. Four babies had transient arrhythmias which were resolved spontaneously. Compared to Holter monitoring, the sensitivity of the ECG was only 89% in the study done by Badrawi N et al.[14] Where as in present study sensitivity of ECG was 94%.

CONCLUSION

On the basis of our experience authors conclude that diagnostic yield was low in infants; however, HM enables cumulative evaluation of heart rhythm and rhythm variability, which is important in diagnosing silent arrhythmias in high risk groups. Holter monitoring completes their diagnostic work up and helps in proper management. Arrhythmias in infants are not common events and proper diagnosis and management of these diverse rhythm disturbances is challenging It is important for physicians who attend to this group of patients to know how to recognize rhythm disorders, the factors for development of arrhythmias, and the available diagnostic and therapeutic options.

The small sample size was one of our limitations in this study.

ACKNOWLEDGEMENTS

Authors would like to thank Dr Pramod Sharma, Senior Professor and Head Pediatrics, Dr. Mohan Makwana, Professor, Pediatrics Dr. S. N. Medical College, Jodhpur, Rajasthan, India.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Baghel A, Kumar M, Soni JP, Agarwal M, Kumar R. Experience with Holter monitoring for evaluation of infant arrhythmia. Int J Contemp Pediatr 2019;6:1362-6.