

AMBULATORY ELECTROCARDIOGRAPHIC MONITORING IN HEALTHY NEWBORN INFANTS*

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SUMMARY: Alpay F, Çeliker A, Lenk MK, Özcan O, Tanındı Ş, Işık E. (Department of Pediatrics and Cardiology, Gülhane Military Academy of Medicine, Ankara, Turkey). Ambulatory electrocardiographic monitoring in healthy newborn infants. Turk J Pediatr 35: 163-170, 1993.

Twenty-four hour ambulatory electrocardiographic monitoring is a useful method to document dysrhythmias and to assess treatment response. Various studies have been done in the pediatric age-group to determine normal heart rate values.

In this study we determined the heart rate and rhythm patterns of 25 healthy newborn infants whose ages ranged between 3-10 days (mean 6.5 days). There were 15 males and 10 females. The maximum heart rate in these infants was 175-231 beats/min (207 ± 14), minimum heart rate 60-121 beats/min (93 ± 16) and the average heart rate was 130-161 beats/min (143 ± 9). Five infants (20%) demonstrated marked sinus dysrhythmia, seven infants (28%) had ventricular premature contractions, two infants (8%) had supraventricular premature contractions, and five infants (20%) showed junctional rhythm disturbance. The sinus pause did not exceed 1.2 sec and there was no evidence of atrioventricular conduction disorders, or supraventricular-ventricular tachycardia attacks.

Our results were consistent with previous studies carried out in newborn infants. Dysrhythmias were detected during 24-hour ambulatory electrocardiographic monitoring in our study group. Since they were generally benign, they need no treatment.

Key words: 24-ambulatory electrocardiographic monitoring, newborn infants, dysrhythmia.

Cardiac dysrhythmias are relatively rare in newborns because resting surface electrocardiograms (ECGs) are usually performed over a short time period¹⁻⁶. Since 24-hour ambulatory ECG monitoring (AEM) is now available, various types of dysrhythmias, including those which are relatively benign such as sinus pause and second degree type 1 atrioventricular block have been detected in healthy newborns¹⁻⁶.

Several AEM studies have been conducted in special populations of healthy newborn infants⁷⁻¹⁰, and results indicate that there seems to be a wide range of bradydysrhythmias and tachydysrhythmias in the normal neonate¹⁻⁶.

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This paper reports the results obtained from AEM studies performed in 25 healthy full-term neonates to determine heart rate and detect the presence of dysrhythmias. The birthweights of the neonates did not exceed 2500 g.

Material and Medhods

Healthy newborn infants were defined as those presenting with no structural heart defects or symptoms of hypoglycemia, hypocalcemia, hyperbilirubinemia, polycythemia and septicemia. Between 1 November 1990 and 30 June 1991, AEM was obtained for 25 babies (15 males, 10 females), aged 3 to 10 days (mean 6.5 days); born in the Obstetrics Unit of Gülhane Military Academy of Medicine. The results of the cardiovascular examination and regular electrocardiography were normal for all subjects.

AEM was performed using a two channel 24-h portable tape recorder (Hewlett-Packard, U.S.A.). The tapes were played and analyzed using an ECG high-speed analyzer. Recordings with interference were deleted full disclosure of all ECGs were not obtained. The analyzer was only able to determine RR and PP interval changes. Thus several supraventricular and ventricular premature beats, sinus pause, heart rate trend curves and heart rate histograms were easily interpreted (Fig. 1).

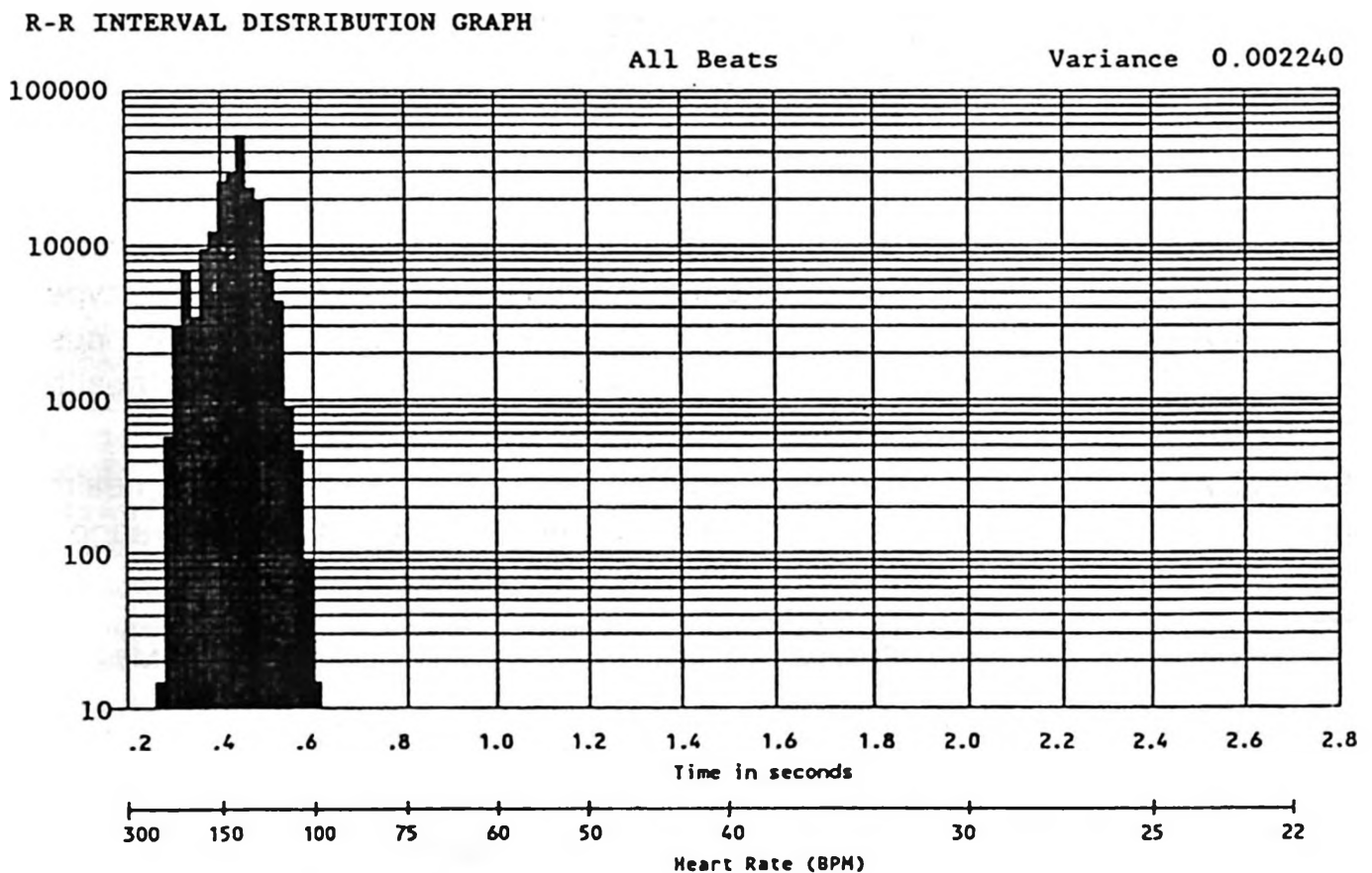


Fig. 1: R-R interval distribution graph. It shows a striking relatively narrow R-R interval distribution. BPM: beat/min.

Sinus arrhythmias were classified using the criteria of Brodsky et al¹¹; irregular sinus arrhythmias with adjacent cycle lengths varying by 10% to less than 50% (mild), 50% to less than 100% (moderate), and 100% or more (marked). Supraventricular and ventricular premature contraction were defined according to the P wave, PR interval, QRS interval and T wave changes⁶⁻¹². First degree atrioventricular block (AV) was defined as a PR interval of 1.8 s or more. The Wenckebach type AV block was defined as gradual prolongation of the PR interval terminating in a nonconducted P wave a dropped ventricular beat⁶⁻¹². Mobitz II AV block and complete heart block are described elsewhere⁶⁻¹².

Results

All infants were predominantly in sinus rhythm and showed a minimal continuous irregularity of rate (Fig. 2). The heart rate fluctuated widely in the newborn infants. The maximum heart rate was 207 ± 14 beats/min (range 175-231),

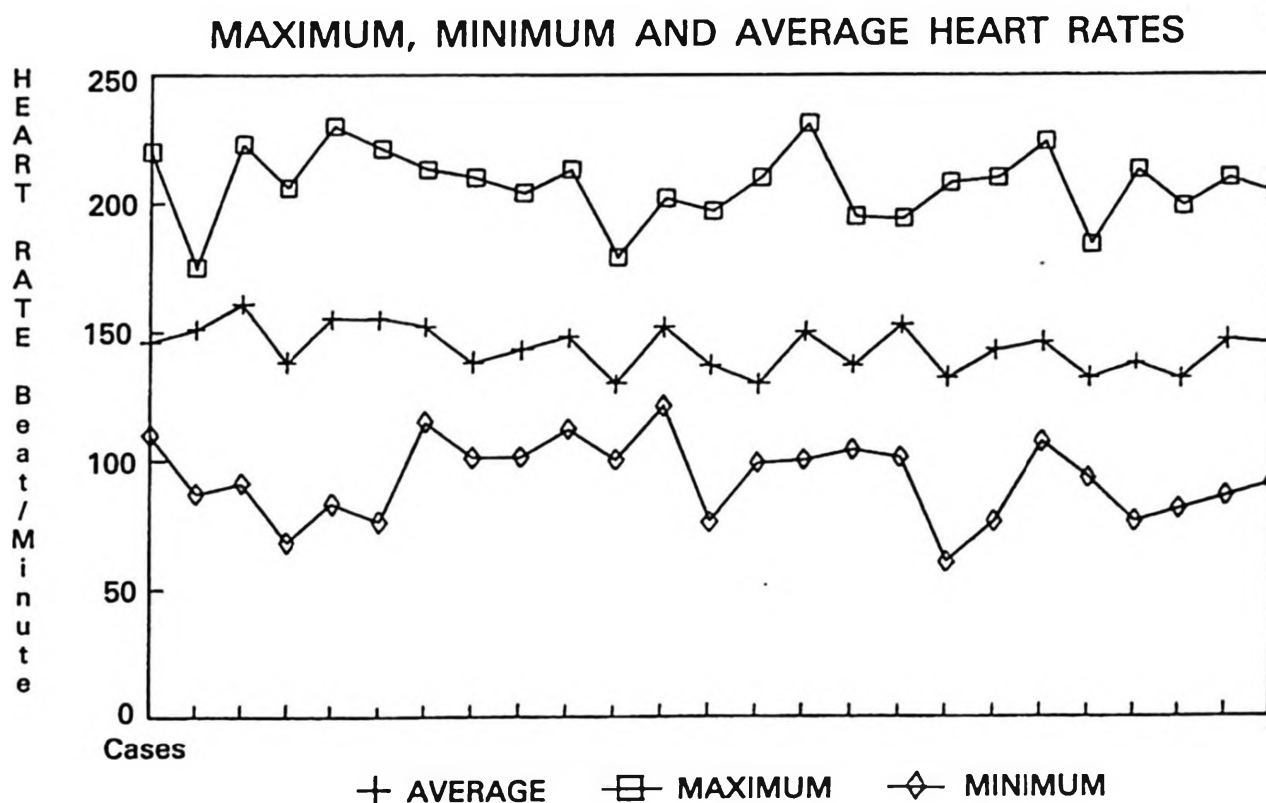


Fig. 2: Maximum, minimum and average heart rates. Heart rate values are shown for all cases. Each point represents one subject.

minimum heart rate 93 ± 16 beats/min (range 60-121) and average heart rate was 143 ± 9 beats/min (range 130-161) (Table I).

Mild or moderate sinus arrhythmias were detected in all subjects, however, marked sinus arrhythmias were determined in only five neonates (20%). Sinus

pause was not detected in our study population beyond marked sinus arrhythmias (Table II).

Ventricular premature contractions (VCPs) were the most common type of dysrhythmia observed in our study group (Fig. 3). Seven infants (28%) had at least one VPC/24 hours. There was a 12% incidence of subjects with five VPCs or more. There was no bigeminy, trigeminy or ventricular tachycardia.

Supraventricular premature contractions (SVPCs) were the second common type of dysrhythmia observed. Two full-term newborns (8%) had several SVPCs during

Table I: Clinical and 24-Hour Ambulatory Electrocardiographic Data in Full-Term Neonates

	Mean $\pm$ SD	Range	
Age (day)	6.5 $\pm$ 1.9	3 - 10	
Weight (g)	3232 $\pm$ 4.1	2500 - 3920	
Hemoglobin (g/dl)	18.7 $\pm$ 2.9	14.2 - 26	
			Previous Reports ¹⁻⁶
Minimum Heart Rate (beat/min)	93 $\pm$ 16	60 - 121	55 - 75
Maximum Heart Rate (beat/min)	207 $\pm$ 14	175 - 231	147 - 240
Average Heart Rate (beat/min)	143 $\pm$ 9	130 - 161	

Table II: Dysrhythmias Detected During Ambulatory-24 Hour Electrocardiographic Monitoring

	No of Patients	%	Previous Reports %
Sinus Dysrhythmia	25/25	100	100
Marked	5/25	20	?
Premature Ventricular Contractions	7/25	28	6 - 17
Premature Atrial Contractions	2/25	8	2 - 33
Junctional Rhythm	5/25	20	18 - 70
Sinus Pause	—	—	5
AV Block	—	—	4 - 6

AV: atrioventricular

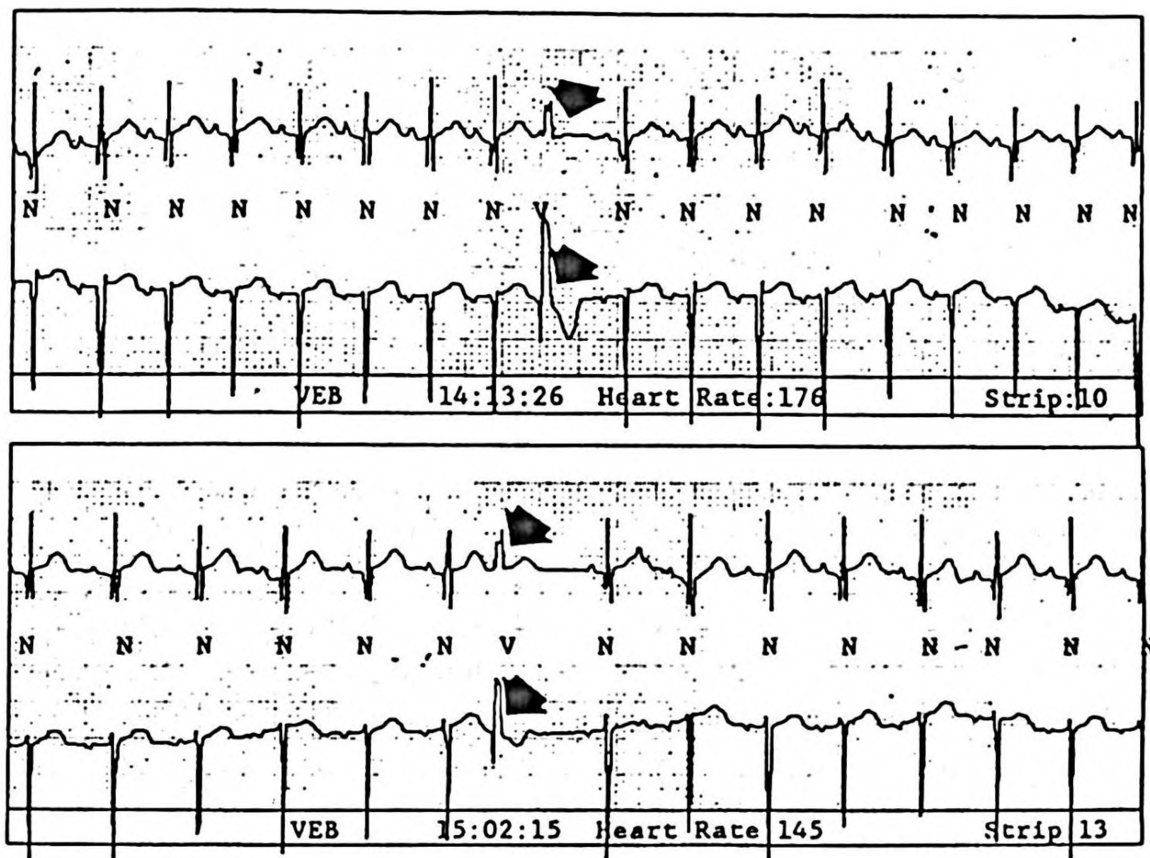


Fig. 3: Ventricular premature contractions (black arrow) in a newborn infant.

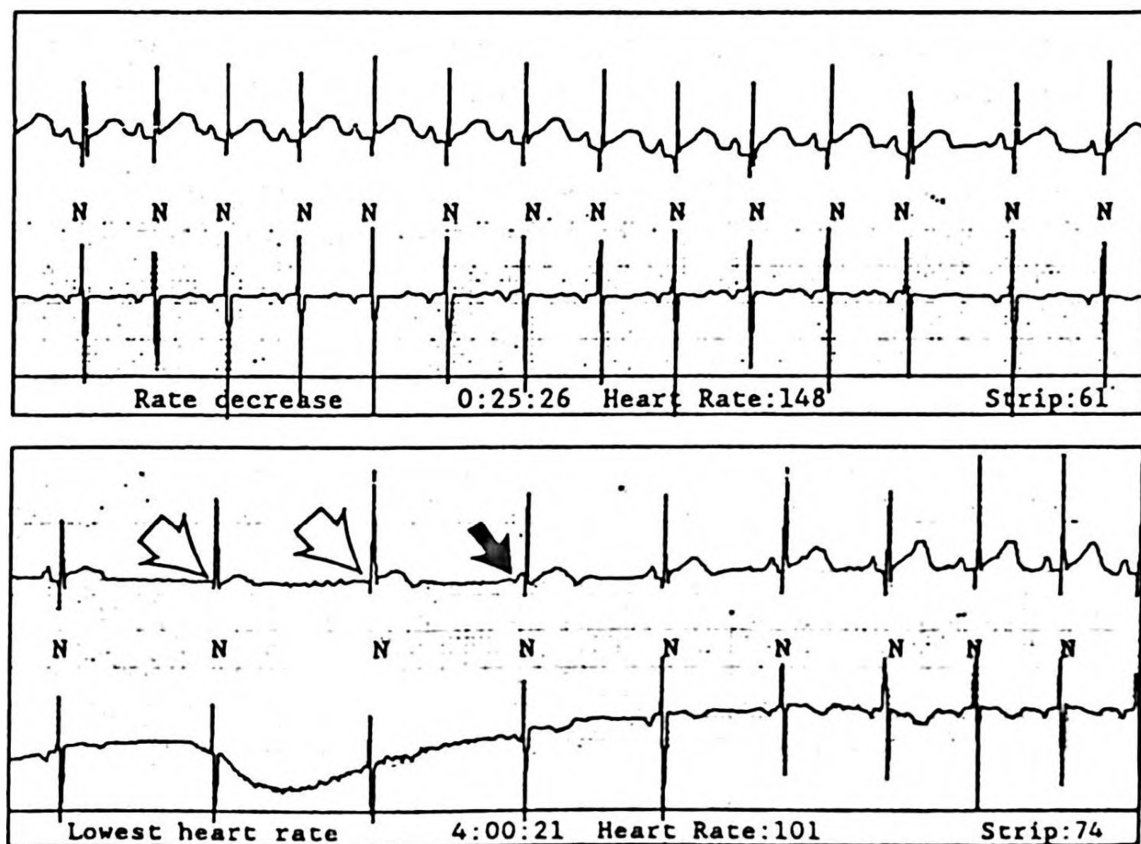


Fig. 4: Junctional escape (white arrow) and supra-ventricular escape (black arrow) in a newborn during the lowest heart rate episode.

AEM. Supraventricular tachycardia attacks were not noted in the study group. Junctional rhythm disturbance was observed in five infants (20%) during nighttime recordings. This rhythm was usually detected during the lowest heart rate episode (Fig. 4). There was no evidence of first and second degree type 1 block (Wenckebach) in our study group.

Discussion

The heart rate range detected in these healthy newborn infants were similar to previously reported studies¹⁻⁶. The mean lowest rate measured by AEM was 93 beats/min, with a standard deviation of 16. Heart rates as low as 60 beats/min were recorded over shorttime periods and 20 percent of these infants experienced brief episodes of junctional escape rhythms during their lowest rates. Sudden episodes of bradycardia are a distinct feature of cardiac rhythm in this age group¹⁻⁶. Studies have not been able to discern if there is a correlation between heart rate and respiratory pattern changes in sudden infant death syndrome⁷⁻¹⁰. Southall² found that 72 percent of healthy newborn infants had sinus pauses, namely complete sinoatrial exit block, sinus arrest, 2:1 sinoatrial block and sinoatrial Wenckebach block with the longest escape interval being 1.8 s. On the other hand Nakashima¹ did not find any sinus pause attacks in his newborn group. Montague⁵ reported a sinus pause attack that lasted 840 milliseconds in one newborn subject although we did not detect any sinus pauses, in our infant group various sinus arrhythmias were present. We do not have full disclosure of 24 hour ECGs, but it not affect the results.

There is a greater incidence and frequency of VPCs over a 24-hour period in older children than in younger children⁶⁻¹¹. Nakashima¹ reported an 18 percent incidence of VPCs in his newborn infant series. VPCs were also a common occurrence in our study group; seven newborns (28%) had at least one VPC during the 24-hour AEM. In various other studies the incidence of VPCs in infants series has also been reported to be low¹⁻⁵. In conclusion, our results may be due to different recording and playback scanner units which are more sensitive.

Montague et al⁵ conducted a study to investigate cardiac rhythm in 29 newborn infants with a mean age of 3.5 days. They found that only two infants experienced a SVPC which occurred at the beginning of the monitoring. However, Nakashima¹ reported a high incidence of SVPCs in healthy neonates. Of 80 full-term infants studied using 24-hour AEM, Southall et al⁴ detected SVPCs in nine of these infants. They concluded that cardiac rhythm seems to be more stable in infants than in older children and adults and speculated that premature contractions disappear soon after the hemodynamic state is stabilized in the first few days of life¹⁻⁴. In another study, Southall² reported that 85 percent of dysrhythmias can not be detected after 12 weeks of age. In our study group, the incidence of SVPC

was 8 percent. We were unable to explain the relatively low incidence of SVPCs detected in our newborn infant group.

It is very difficult for pediatricians to ascertain whether cardiac dysrhythmias or abnormal findings on the ECG of newborn infants are a prediction of Sudden Infant Death syndrome⁷⁻¹⁰. The results of our study offered no clues regarding Sudden Infant Death Syndrome. AV block was not demonstrated in our newborn infant group, although an incidence of 4-6 percent has been reported in various studies²⁻⁴. There was also no detection of AV block in the patients Nakashima¹ and Montague et al⁵ studied. Since it is known that the incidence of AV block increases with age, these findings are not surprising^{1,6}.

A few studies, involving relatively large groups of infants documented infrequent supraventricular and ventricular attacks of tachycardia^{3,4,9}. Nakashima¹ and Montague et al⁵ did not detect these types of dysrhythmias in their newborn infant groups. Our results were consistent with these studies.

In conclusion the dysrhythmias detected in our newborn infants group during 24-hour AEM were generally benign and needed no treatment. We found no evidence of conduction disturbances or sinus node dysfunction in the infants. Our results indicate that the newborn infants we studied have a relatively stable hemodynamic status. It must be stressed, however, that dysrhythmias, other than the above-mentioned, must be managed appropriately.

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