Original Article

Effect of Age and Sex on QRS Axis Deviation of Healthy Indian Population and Its Clinical Significance

Physiology Section

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ABSTRACT

Introduction: Electrocardiogram from 150 apparently healthy adults in the age group of 20–80 years, were analyzed using Schiller Cardiovit AT 1,3 channeled ECG machine to study the impact of increasing age and sex on QRS Axis deviation. The mean electrical axis was recorded in frontal plane for QRS complex using the Hexaxial Reference system.

Result: It was observed that there occurred highly significant leftward shift of QRS frontal plane axis with increase in age. This shift of QRS axis was also found on comparison among males and females of the three groups separately. However there was no significant variation of QRS frontal plane axis with sex in any of three age groups.

Conclusion: It was concluded from the present study that age influences the prevalence of electrocardiographic variations and the diagnostic criterion for abnormality must be based upon the sound understanding of the normal electrocardiogram.

Discussion: The leftward shift of the frontal QRS axis with age was attributed to increased left ventricular wall thickness.

Key Words: ECG, QRS axis deviation, Hexaxial reference system, Age, Sex

INTRODUCTION

The process of normal aging in the absence of disease is accompanied by a myriad of changes in body systems. Health and lifestyle factors together with the genetic make-up of an individual determine the response to these changes. In India, the absolute size of the aged population is considerable. The projected figures (for >65 years) for the year 2000 and 2010 are 8% and 9% respectively. The influence of age and sex on ECG measurements has been documented from as far back as 1961[1] .

With advancing age, degenerative changes occur in heart muscle and its conduction system. Some of the pathways of pacemaker system may develop fibrous tissue and fat deposits. The SA node loses some of its cells. Aging has been shown to be associated with significant decrease in the intrinsic heart rate .The purpose of the present study was to determine the presence and extent of sex and age differences in heart rate in an adult population.

MATERIALS AND METHODS

The present study has been conducted on 150 healthy individuals (both male and female) in age group of 20–80 years. Individuals found free of any cardiovascular abnormality were taken up for the study. The ECG was recorded in supine position and fasting state.

These were divided into 3 groups depending upon the age:-

Group A	20–39 years	=	50
Group B	40–59 years	=	50
Group C	60–80 years	=	50

All the subjects were interviewed in accordance with the pro forma enclosed and detailed history and clinical examination were taken. Informed consent was taken from the study participants.

- **Detailed History**

Complete history with special emphasis on cardiovascular system such as history of pain in the chest, dyspnoea, palpitation, oedema feet were noted.

- **Clinical examination**

Careful general physical examination was carried out, particularly cardiovascular examination to exclude any cardiovascular disease.

Electrocardiogram

Electrocardiograph Machine: A conventional 12 lead electrocardiogram was recorded on Schiller Cardiovit AT 1, 3 channeled ECG machine. The machine has four stainless steel electrodes and six precordial suction electrodes. 12 lead ECG was recorded which includes:

1. 3 bipolar limb leads- L I, L II and L III
2. 3 augmented unipolar limb leads- aVR, aVL, and aVF;
3. 6 unipolar chest leads- V_1, V_2, V_3, V_4, V_5 and V_6

A great care was taken to avoid the presence of any conducting material in the vicinity of electrocardiogram machine. The electrocardiogram was recorded in supine position and fasting state. The sensitivity of the machine was so adjusted that a potential difference of 1mV caused a deflection of 10 mm. As a routine the paper speed used during the procedure of recording the electrocardiogram was 25mm/sec.

Electrical Axis: The mean electrical axis was recorded in frontal plane for QRS complex. The method for determining the mean QRS axis in frontal plane was based on the Hexaxial Reference system which is formed by a combination of two triaxial reference systems, one formed by the three standard leads and the other by the three unipolar extremity leads.

Axis Deviation: The normal axis lies between –30° and +110°. Within the range of normal (–30° to +110°), left axis deviation (0 to –30°) represents a normal horizontal heart position; and right axis deviation (+75° to +110°) represents a normal vertical heart position.

Statistical Consideration: All the data was analyzed statistically.

RESULTS

[Table/Fig-1 & 2] represents the distribution of the study participants according to age and sex respectively.

[Table/Fig-3] shows mean and SD of QRS axis in the three groups A, B and C. The result shows that with increasing age mean QRS Frontal plane axis shifts towards left. On using ANOVA test, F value comes out to be 11.46 which shows HS inter-group difference ($p < 0.01$). On comparing group A with B, t value is 1.46, which is NS ($p > 0.05$), A with C t value is 4.17 which is HS ($p < 0.01$) and B with C the difference is again HS ($p < 0.01$), with t value of 3.24.

[Table/Fig-4] shows mean and SD of QRS axis in males of the three groups A, B and C. The result shows that with increasing age mean QRS Frontal plane axis shifts towards left. On using ANOVA test, F value comes out to be 6.94 which shows HS inter-group difference among males ($p < 0.01$). On comparing group A with B, t value is 1.27 which is NS ($p > 0.05$), A with C t value is 3.58 which is HS ($p < 0.01$) and B with C the difference is S ($p < 0.05$), with t value of 2.20.

[Table/Fig-5] shows mean and SD of QRS frontal plane axis in females of the three groups A, B and C. The result shows that with increasing age, mean QRS frontal plane axis shifts towards left.

Group A (20–39)			Group B (40–59)			Group C (60–80)		
Range	No.	%	Range	No.	%	Range	No.	%
20–24	19	38	40–44	5	10	60–64	12	24
25–29	9	18	45–49	22	44	65–69	11	22
30–34	7	14	50–54	16	32	70–74	13	26
35–39	15	30	55–59	7	14	75–80	14	28
Total	50	100	Total	50	100	Total	50	100
Mean±SD	27.84 ± 6.73		48.32 ± 4.27			69.4 ± 6.50		

[Table/Fig-1]: Distribution according to age

Group	Male		Female		Total	
	No.	%	No.	%	No.	%
A	28	56	22	44	50	100
B	19	38	31	62	50	100
D	33	66	17	34	50	100

[Table/Fig-2]: Distribution according to gender

Group	No.	Range (degrees)	Mean ± SD (degrees)
A	50	0–90	51.26 ± 26.55
B	50	6–89	44.04 ± 22.45
C	50	–60 – +110	23.50 ± 38.79

Statistical Analysis

	A vs B	A vs C	B vs C	F value
't' value	1.46	4.17	3.24	11.46
'p' value	>0.05	<0.01	<0.01	<0.01
Sig.	NS	HS	HS	HS

[Table/Fig-3]: Showing mean ± sd of qrs frontal plane axis in the three age groups

Group	No.	Range (degrees)	Mean±SD (degrees)
A	28	0–90	56.92 ± 25.54
B	19	14–82	47.57 ± 24.19
C	33	–60 – +76	29.94 ± 33.19

Statistical Analysis

	A vs B	A vs C	B vs C	F value
't' value	1.27	3.58	2.20	6.94
'p' value	>0.05	<0.01	<0.05	<0.01
Sig.	NS	HS	S	HS

[Table/Fig-4]: Showing comparison of qrs frontal plane axis among males of the three groups

Group	No.	Range (degrees)	Mean ± SD (degrees)
A	22	0–90	44.04 ± 26.03
B	31	6–89	41.87 ± 21.44
C	17	–60 – +110	11 ± 46.42

Statistical Analysis

	A vs B	A vs C	B vs C	F value
't' value	0.32	2.62	2.59	6.92
'p' value	>0.05	<0.05	<0.05	<0.01
Sig.	NS	S	S	HS

[Table/Fig-5]: Showing comparison of qrs frontal plane axis among females of the three age groups

On using ANOVA test, F value comes out to be 6.92 which shows HS inter-group difference among females ($p < 0.01$). On comparing group A with B, t value is 0.32 which is NS ($p > 0.05$), A with C t value is 2.62 which is S ($p < 0.05$) and B with C t value is 2.59 which is again S ($p < 0.05$).

[Table/Fig 6] shows comparison of QRS Frontal plane axis between males and females of the three groups. On comparing males and females of groups A, B and C, statistical analysis shows result to be NS ($p > 0.05$) with t value of 1.73, 0.87 and 1.49 respectively.

DISCUSSION

In this study, 150 healthy individuals (both male and female) in age group of 20–80 years were physiologically analyzed on the basis of QRS axis deviation. Changes in QRS frontal plane axis with age and sex were noted and statistically analyzed. The conclusion of the present study was compared with those of previous studies and results were drawn.

Ewy GA (1979)[2] has conducted similar studies on different ethnic groups. He concluded that the incidence of left axis deviation in the Indian schoolchildren is more than ten times the incidence reported in other populations of normal children of comparable age.

Group	Sex	No.	Range (degrees)	Mean ± SD (degrees)	't'	'p'	Sig.
A	M	28	0–90	56.92 ± 25.54	1.73	>0.05	NS
	F	22	0–90	44.04 ± 26.03			
B	M	19	14–82	47.57 ± 24.19	0.87	>0.05	NS
	F	31	6–89	41.87 ± 21.44			
C	M	33	–60 – +76	29.94 ± 33.19	1.49	>0.05	NS
	F	17	–60 – +110	11 ± 46.42			

Table/Fig-6: Showing comparison of qrs frontal plane axis between males and females of the three groups

Bressan et al. (1998) [3] and Xie et al. (2000) [4] have also reported similar results of leftward shift of QRS frontal plane axis.

Assantachai et al. (2002) [5] concluded that the most common electrocardiographic abnormality in normal older men was left axis deviation and was found consistently more often than in older women.

The deviation of heart electrical axis to a more left position with increasing age was also supported in studies by Varlamova and Evdokimov (2003), [6] Wu et al. (2003), [7] Devkota et al. (2006) [8] and Chermnykh and Loginova (2006) [9].

Surawicz B (2009) [10] concluded that the mean frontal plane electrical axis, determined by the vector of the maximal (dominant) QRS deflection, depends on age and body habitus . It shifts to the left with increasing age.

The leftward shift of the frontal QRS axis with age is attributed to increased left ventricular wall thickness which is due to

(i) decreased number of myocytes (due to necrosis and apoptosis) but increased left ventricular myocyte size,
(ii) altered growth factor regulation,
(iii) focal collagen deposition.

CONCLUSION

In the present study, it was observed that there occurred highly significant leftward shift of QRS frontal plane axis with increase in age. This shift of QRS axis was also found on comparison among males and females of the three groups separately. However there was no significant variation of QRS frontal plane axis with sex in any of three age groups.

It was concluded from the present study that age influences the prevalence of electrocardiographic variations and the diagnostic criterion for abnormality must be based upon the sound understanding of the normal electrocardiogram.

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