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General Medicine

INCIDENCE OF "J WAVE SYNDROMES" AND THEIR RISK STRATIFICATION IN RESIDENT DOCTORS AND YOUNG FACULTY STAFF OF A TERTIARY CARE TEACHING HOSPITAL

KEY WORDS:

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INTRODUCTION:

J wave or the Osborn wave Is a positive deflection found at the end of the QRS complex; which is called 'J point' and has an elevation of ≥0.1 mV. It was known as a distinct delta wave prior, which is partially buried in the QRS complex as the ORS notching or slurring [1] It was first described by John J Osborn in 1953, hence the name. [2] The other synonym used in literature for expressing this is a camel-hump sign, Hathook junction, hypothermic wave, K or H- wave, or current of injury. [2,3]

It was first described by Kraus et al in 1920-22. In 1938, it was accidentally seen in a hypothermic patient by Tomaszewski. Since then, it is been studied with great interest and elaborately documented in the literature.[3] Haïssaguerre et al 2008 reported a larger cohort of idiopathic ventricular fibrillation (IVF) and labelled the ECG finding as Early Repolarization [ER]. [4]

This 'J wave' was considered benign or not contributory to any cardiac events till recently as it was seen in young relative patients (average age 41 years), athletes, and patients with bradycardia. [5,6] But in the recent past, it is identified as a proarrhythmic state and can lead to IVF ultimately leading to sudden cardiac death. [1] This entity is named 'J-wave syndrome' (JWS); it is the combination of Brugada syndrome (BrS) and Early Repolarization Syndrome (ERS) [1] JWS is associated strongly with sudden cardiac death especially in younger individuals without any cardiac issues in the past. The incidence of JWS is more in Southeast Asia; very few studies are done in this regard. We intend to study J-wave syndrome incidence among residents and young faculty staff from a tertiary care center. We will also study the possible risks of imminent arrhythmias in our cohort.

OBJECTIVE:

To estimate the incidence of J wave syndromes among medical resident doctors and young medical faculty members of a tertiary health care teaching institute.

MATERIAL AND METHOD:

An observational study was planned to be undertaken in a tertiary care center. Data was collected for fifteen months (January 2020 – March 2021) and the total duration of the study was two years (January 2020- December 2021). Male and female medical resident doctors and young faculty staff members less than 40 years of age from all clinical, pre, and para-clinical departments and who were willing to give consent for the participation in the study were enrolled in the study.

We excluded individuals with permanent pacemakers, underlying known congenital or rheumatic or ischemic heart disease. Known cases of diabetes Mellitus with or without hypertension. Individuals who are on chronic medications that can alter ECG.

The required sample size for the present study was calculated considering three factors namely a 90% confidence level, the incidence of J Wave Syndrome in previous literature, and the allowable level of margin of error a sample size of 170 was finalized.

Informed consent was received from the study participants. A Proforma showing socio-demographic and clinical characteristics of study participants including ECG findings. A predesigned, pilot-tested validated questionnaire was developed and used as a major tool for the collection of data. Relevant information about the sociodemographic characteristics of participants was noted. The questionnaire also contained information about family history of sudden cardiac death (SCD) and history of transient loss of consciousness (TLOC). A detailed clinical evaluation of all participants was performed, and the data was filled up in the respective proforma. A trained technician recorded the ECGs using a paper speed of 25 mm/s at 10 mm/mV. After a resting period of at least 5 minutes, the ECG was registered in the supine position using a numerical electrocardiograph with the capability to review and modify the value of the parameters.

Resting 12-lead ECG for each participant was analyzed independently by two trained cardiologists from the same institute and the findings were reported with a special mention of the presence or absence of a J wave syndrome.

Family history of sudden cardiac death was recorded in males and females separately. Any history of syncope or transient loss of consciousness was noted. Different types of ERS patterns were observed and noted.

After collecting the data, classification and tabulation were done under the appropriate heading to obtain the summary values for further statistical treatment. Continuous variables were expressed as means ± SD and quantitative data comparison of all clinical indicators was done by Mann-Whitney U-test. The Chi-square test was used for qualitative data whenever two or more two groups were used to compare. Two-tailed p-value less than 0.05 was considered statistically significant. Statistical analysis was done with Statistical Package for the Social Sciences (SPSS) Version 20 software (IBM SPSS Statistics Inc., Chicago, Illinois, USA).

RESULTS:

Data from a total number of 170 participants were recorded who fit the inclusion and exclusion criteria and gave consent for the study.

Out of 170 individuals; 116 (68.26%) were males and 54 (31.74%) were females. The age range of participants was from 21 years to 40 years. 26–30-year age group is the commonest age group in both males 68 (40%) and females 30

(17.64%). The average age 27.63 years (range of 24-40 years) was and the median age was 26 years. In males, the average age was 27.43 years and the median age was 26 years; and in females, it was 27.8 years and 27 years respectively Out of the 170, the total number of individuals with a family history of sudden cardiac death was three (i.e., 1.76%). All were males and none were females.

Only 3 (1.76%) showed syncopal/transient loss of consciousness and all were males.

J wave syndrome ECG pattern was detected among only 5 (2.94%) participants. In the current study, the estimated incidence of J wave syndromes among study participants was 2.94%. Of the 5 participants with unusual ECG, 4 (80%) were males and one (20%) was female. The most predominant ERS pattern was observed in the lateral leads (ERS Type 1) among 3 (60%) participants whereas ERS Type 2 (inferolateral leads) pattern was seen among the remaining 2 (40%) participants. The majority of participants showed ECG patterns within normal limits 165 (97.1%).

Considering gender differences, the study could not reveal any statistically significant association (p= 0.53) between the gender of participants and ECG changes.

The present study attempted to establish the correlation between the age of participants and associated ECG changes. A statistically significant association between ECG changes and age was observed (p= 0.03), as ECG changes showed higher mean age (31.60 years; SD 6.656) as compared to those without ECG changes (27.52years; SD 3.331). (Table: 1)

Only 3/170 (1.8%) patients had a history of transient loss of consciousness; a statistically significant association (p=0.001) was noted between ECG patterns of participants and the history of transient loss of consciousness. (Table: 2)

Only 3/170 (1.8%) participants showed a family history of sudden cardiac death. The comparison of family history of SCD and ECG changes showed statistically significant results (p= 0.001). (Table: 3)

Table: 1 Association Between Age And Ecg Changes (n=170)

ECG	Number	Mean	SD	P-value
No	165	27.52	3.331	0.03
Yes	05	31.60	6.656	
Total	170	27.64	3.506	

Table: 2 Ecg And Family History Of Sudden Cardiac Death (n=170)

			No	Yes	Total	P-value
ECG	No	Number	165	0	165	0.001*
		%	100.0%	0.0%	100.0%	
	Yes	Number	2	3	5	
		%	40.0%	60.0%	100.0%	
	Total	Number	167	3	170	
		%	98.2%	1.8%	100.0%	

Table: 3 Ecg And History Of Transient Loss Of Consciousness

			No	Yes	Total	P-value
ECG	No	Number	165	0	165	0.001*
		%	100.0%	0.0%	100.0%	
	Yes	Number	02	03	05	
		%	40.0%	60.0%	100.0%	
	Total	Number	167	03	170	
		%	98.2%	1.8%	100.0%	

DISCUSSION:

BrS is an autosomal dominant genetic disorder. A faster depolarization of cardiac action potential occurs by increased Na^+ ion influx due to mutation of the SCN5A /SCN10A gene located on chromosome 3p21-24. In an ECG it is represented as a pseudo-right bundle branch block and a consistent ST-elevation is shown over V1 and V2 leads. The presence of normal and abnormal tissue in the same site gives rise to heterogeneous myocardial refractory periods mainly in the right ventricle. [1-7] The overall effect of this miss arrangement results in ventricular arrhythmias. The actual prevalence of BrS is not well studied; but overall, the Brugada type -ECG pattern is commonest in the Southeast Asian population. [1] Japan has a prevalence of around 0.7% - 1% and in USA it is 0.012% - 0.4%. (5,6u) Whereas the prevalence in patients with IVF is 3%-24%. [7]

In ERS there is 'J-point elevation' i.e., QRS-t variant seen in an ECG. It is defined as a J-point elevation of $\geq$ 0.1mV in two adjacent leads (viz. II, III, and/or V4, V5, V6) which morphologically looks like a slurred or notched appearance. [7] According to the ECG and its association with arrhythmic risk ER is classified into four types; Type 1 – mainly benign; ER is seen in precordial leads, Type 2 – carries moderate risk and the ER is seen in inferior and inferolateral leads, Type 3 – relatively high risk and a small risk of absolute sudden death. ER is seen in inferior, lateral, and right precordial leads, Type 4 – ER in right precordial leads is called the Brugada Syndrome. [8] ERS with predominantly J waves in inferior leads has a higher risk of mortality due to cardiac causes. [5,9,10]

JWS is a constellation of clinical entities where J waves are seen on EGC and also carries a risk of development of arrhythmias and sudden cardiac death. BrS and ERS represent these clinical entities majorly. [11] J waves were considered to be physiological and an ECG finding common in athletes, but the last 2 decades gathered more details of JWS to link it to IVF and SCD. [8,11]

Few features of a benign and malignant variety of JWS are listed below [5,12]

Features	Physiological J Wave	Pathological J wave
J point Elevation	<0.1 mV	>0.2 mV
Height of J wave	1-2 mm	>2mm
Descent of J wave	Up-sloping	Horizontal or Down sloping
ECG Leads	Only V4-6 or II, III, aVF	Both, V4-6 plus II, III, aVF

In the current study, the incidence of J Wave Syndrome ECG was observed to be 2.94%. Overall, only 2.94% of participants had JWS ECG patterns in the current study, which was lower than earlier population-based reports. [13]

The global prevalence was shown to be around 5.8% if J point deflection with $\geq$ 1 mm is seen in inferior or lateral leads and it is 0.6% for a deflection of $\geq$2 mm is considered in the same leads. In MONICA/KORA study with the central European population, the prevalence was 13%. ARIC study in 2011 showed a prevalence of 12%. Uberoi reported it to be 14% when using the definition of QRS slurring. [14]

In a study by Kui C et al JWS showed a prevalence of 7.26%. [15] A similar prevalence was seen by Perez et al with a prevalence of 2.3%. [16] In general, in the British population, JWS was seen as 7.7% as studied by Reinhard et al in 2011. [14] Noseworthy et al and the authors studied the population of Framingham heart study in which they found an ERS-like pattern in 6.1%. In the same study, it was found to be 3.3% of the population studied in the Health 2000 survey from Finland. [17]

JWS was more common in the Asian population as compared to the western population. [13] Studies like that done by Akhmedov et al found ERS or JWS to be more in Africans (9.1%) followed by Asians (2.6%) and Latin Americans (2.2%). [13] In a study where 1817 Chinese healthy population

has studied the prevalence was shown to be 7%.[15] While in 5976 Japanese atomic bomb survivors were studied it was found to be 24%. [13]

Grusin et al 1954 studied the African population in which they found 25% prevalence and 34% in the young Nigerian population.[13] When a comparison of African Americans and white Americans was done the prevalence of ERS-like patterns was seen at 15% and 1% respectively. [13] Fuyuta et al [18] found the prevalence of the JWS ECG pattern as high as 2.03% among the hospital-based population in Japan whereas in the study conducted by Kui et al [13,15] the prevalence of 7.26% was revealed among healthy Chinese participants. [15]

It is hence commonly observed in studies overall that, Asians, African and African Americans are the group of the population where the JWS-like ECG pattern is more prevalent.

The study also noted a strong male predominance with 80% of the J wave positive ECG recordings. This finding concurs with the findings of Zumrud et al who found 87% of the JWS population to be male. [19] Antzelevitch C et al showed the prevalence of JWS (BrS and ERS combined) to be >80%-85% in males. [11] Kui C et al found JWS in 89.48% of males in the Chinese population. [15]

These findings are different when we consider athletes. Like in a study by Yong C et al they found that males were more common 90.1% in the clinical population, while were only 55.5% in the Athletes population. [20] In the group of Athletes, 62% were males in which JWS was found in another study. [7]

The male preponderance was ascribed to JWS due to the predilection of high transient outward potassium current in them. [15] Testosterone may play a major role in directing these currents; hence the higher prevalence in males. [13]

Various J wave patterns were observed in the current study. The most prominent detected pattern was >0.1mV in lateral leads followed by >0.1mV in inferolateral leads, >0.2 mV in inferolateral leads, and >0.2 mV in lateral leads. In this study, two patterns i.e., Type 1 (lateral leads) and Type 2 (inferolateral leads) were seen among 60% and 40% of participants respectively. In one of the studies carried out by Kui et al. [15], the most predominant identified ECG pattern was Type 2 with 4.56% followed by Type 1 with 2.2% of participants.

Comparatively lower values (4.4% and 1.4%) were also observed for Type 1 and 2 respectively in the study of Zumrud et al [19] Surprisingly, Tikkanen et al. [5] also reported lesser values in their study in which documented prevalence rates of Type 1 and 2 were 2.4% and 3.6% respectively.

The major risk of JWS overall is the development of arrhythmias and sudden cardiac death. Some of the well-identified risk factors are the history of cardiac signs or symptoms like polymorphic ventricular tachycardia or ventricular fibrillation, and or prominent J waves identified in global leads or Type 1 ST-elevation. [11, 21] A positive family history of SCD is also identified as a prominent risk factor in the patients with ERS if these patients also have ECG patterns like BrS (i.e., the situation we encounter in JWS) will only make a lethal clinical scenario. [11] The existing literature indicates that the location including inferior vs lateral leads and J point elevation of more than 0.2 mV is associated with a significant risk of death from cardiac arrhythmia.[5] However, in the current study, the J point elevation >0.2mV was noted among only 2 (1.17%) participants and all 5 (100%) participants showed J point elevation in inferior and lateral leads. All participants with abnormal ECG were asymptomatic and clinically stable. Other identified risk factors are elicited in the following table:

Table: 5 Risk factors associated with J waves

OTHER POSSIBLE RISK FACTORS
J-waves which are horizontal/downward sloping ST-segment
J-waves which are >0.2 mV
Dynamic changes in J-wave amplitude
Rapidly ascending ST segments with tall R waves
Steep QT/RR segments
Prolong intervals between T(peak) – T(end)
Fragmented QRS or short QT interval
Resuscitation due to cardiac arrest and documented VF or VT
Positive history of SCD in family and or arrhythmia-related syncope
Identified gene mutations for JWS

J point elevation of >0.2mV turned out to be a major risk factor; a strong association with death from cardiac arrhythmias was noted in this population. [5] In the current study, we noted this in two individuals (1.17%). J point elevation of 0.1mV is linked with a 1.28-fold increase in relative risk of death due to cardiac causes; while 0.2mV in similar leads showed a 3-fold increase in the risk factor. [9]

We observed a statistically significant ($p<0.05$) when we compared the history of a transient episode of unconsciousness and family history of SCD to ECG patterns suggesting JWS.

Data is scarce in terms of whether mutations in associated genes are clinically associated with a high risk for SCD. But in many studies, SCN5A gene mutation patients have shown a higher risk of cardiac events over long-term follow-up. [21, 22, 23, 24]

This may be the first study that was implemented to assess the incidence of J wave syndrome and ECG patterns among young medical residents and faculty. As a result, a limited number of studies were available for comparison. The current study predominantly included the male population. The gender differences pertaining to JWS and associated ECG patterns could not be studied in depth due to a limited number of female participants. In this study, conventional 12 lead ECG technology was used. False-positive and false-negative rates may represent limitations pertaining to conventional 12 lead ECG screening in an asymptomatic population. The long-term follow-up of participants should have been done to assess the risk of impending arrhythmias and other cardiac events among them.

CONCLUSION:

A male individual with >0.2mV associated with syncope and or a family history of sudden cardiac death; such individual should be considered at high risk for sudden cardiac death or malignant cardiac arrhythmias. Definite evidence exists which explains the positive relationship between early repolarization, emotional stress, and sudden cardiac death.[25] This was the major reason for selecting health care workers as a target population in the present study. However, multicentric studies with a larger sample size are needed to reinforce the relationship between stress and J wave syndrome. Even though these findings are consistently found in many studies; there is a dire need for large population-based multicentre randomized studies for mapping the natural course of JWS.

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