Increasing Sudden Cardiac Death Predictability among Patients for whom Intracardiac Device were Implanted for Different Indications

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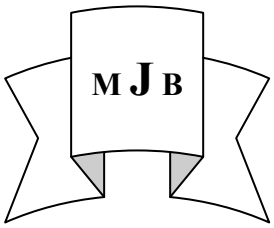

Abstract

Background: sudden cardiac death (SCD) is defined as death due to any cardiac disease that occurs within one hour after the onset of symptoms. Estimation of the prevalence of QRS prolongation in the population with heart failure (HF) ranges between 20-50%, especially with Coronary Artery Disease (CAD) patients with LVEF< 30%. Intra-ventricular conduction delay (IVCD) or LBBB (but not RBBB) had a 50% increase in the risk of cardiac arrest and total mortality.

Aim of study: to test the viability of the following: a cardiac patient who acquires a special clinical triplet is at increasing risk of SCD. , if combined, in a sequence, with IVCD presence).

Study design: retrospective study.

Patients and methods: 53 consecutive patients, have been studied , for whom ICD. were implanted for various indications from 9\2000 - 9\2006 at AL Kadhimiah teaching hospital

Males constituted 41\53 (77.35%), compared to females 12\53 (22.64%) were >46<75 years of age (mean: 60y). All males are > 40<65 years of age. (mean 52ys.)

For all these patients who sustained cardiac death & recovered wither spontaneously or through medical intervention & the event responsible for the syncope were well established by continuous ECG monitoring, full history & full clinical examination along with ECG & ECHO study were done.

Results: Most common ECG findings were Q waves (either due to MI or DCM),while LBBB\ IVCD were relatively uncommon Most common Echo findings were ischemic HF (segmental hypokinesia\akinesia)- especially old anterior akinesia. Sub-group I (StHD in males) constituted 35/53,and.Sub-group II (LVS Dysfunction<40%>30%, StHD and male sex) constituted 30/53 Lastly the sub-group III (IVCD, LVS dysfunction, StHD, and male sex) constituted 9/53,

Conclusions: *20.45% increment in the probability in predicting SCD in the presence of combined IVCD, LVS dysfunction (LVEF<40%>30%), StHD, and male sex ; indicating a significant role of the presence of these combined 4 clinical criteria (IVCD, and LVEF<40%>30%, StHD, and male sex) , as potential predictors of SCD**.**

Recommendations: the presence of 4 clinical criteria in a patient is associated with higher probability of SCD. ; neccessating close and watchful surveillance**.**

Key wards: SCD.; Males; St HD.; LVS Dysfunction ; IVCD.

ازدياد توقع الموت المفاجيء لمرضى فقدان الوعي القلبي بجمع ثلاثة صفات سريرية مع خلل التوصيل البطيني

الخلاصة

المقدمة: يعرف الموت المفاجيء بأنه الموت الناشيء عن أي مرض قلبي والواقع خلال ساعة من حدوث العارض. ويوجد خلل التوصيل البطيني بنسبة ٢٠-٥٠% من مرضى عجز القلب الاكليلي. وهو يزيد من احتمالية التعرض الى الموت المفاجيء و مجموع الوفيات بنسبة ٥٠%،خاصة مع عجز القلب القابض (ذي الدرجة الشديدة٣٠%>)

المرضى والطريقة: فحص ٥٣ مريضآ زرع لكل منهم جهاز الصدمة الكهربائيالزرع لبي، من تاريخ ١٩\٢٠٠٠-١٩\٢٠٠٦ في م. الكاظمية التعليمي: عدد الرجال ٤٢ والنساء ١٢، وأعمار الرجال ٤٠-٦٥ (المعدل ٥٢): قسم المرضى الى ثلاثة مجاميع:الاولى:الرجال مع امراض القلب الانشائية، ليقارنوا مع مرضى القلب الانشائي عند جميع المرضى. الثانية: الرجال مع امراض

القلب الانشائي مع عجز القلب القابض (بين ٤٠-٣٠%)، ليقارنوا مع مرضى عجز القلب القابض عند جميع المرضى. الثالثة: الرجال مع امراض القلب الانشائية، مع عجز القلب القابض (٤٠-٣٠%)، مع خلل التوصيل البطيني، ليقارنوا مع مرضى خلل التوصيل البطيني عند الجميع.

النتائج: نسبة زيادة التوقع في الموت المفاجيء في المجموعة الاولى ٦,٤٧%، وفي الثانية ٩,٩٤%، وفي الثالثة ٢٠,٤٥%

الاستنتاجات: هناك ٢٠,٤٥% زيادة في احتمالية توقع الموت المفاجيء في المجموعة الثالثة (التي تحوي : الذكور، والمرض القلبي الانشائي، وعجز القلب القابض، مع خلل التوصيل البطيني)، اذا قورنت بالمرضى الذين لديهم خلل في التوصيل البطيني فقط.

التوصيات: ان وجود خلل التوصيل البطيني في المريض الذكر وله من العمر : ٤٠ – ٦٥ عاماً، ولديه مرض انشائي قلبي، وعجز قلبي قابض ما بين ٤٠-٣٠%، هو اقرب الى خطر الموت المفاجيء اذا قورن بوجود خلل التوصيل البطيني فقط (دون النظر الى الصفات الاخرى).

المفاتيح: فقدان الوعي القلبي- الذكورة- امراض القلب الانشائية- عجز القلب القابض- خلل التوصيل البطيني.

Introduction

The international classification of diseases, tenth revision, defines sudden cardiac death (SCD) as non-traumatic death due to any cardiac disease; Death must have occurred within one hour after the onset of symptoms. SCD may be due to ventricular tachycardia (VT), ventricular fibrillation (VF) ,asystole, or non arrhythmic cause.[1]

The standard resting 12 lead ECG detect ventricular arrhythmias or evidence suggesting underlying structural heart diseases (StHD) as bundle branch block (BBB.), atrioventricular block (AVB.), left ventricular hypertrophy (LVH.), and Q wave.[2]

Estimation of the prevalence of QRS prolongation in the population with heart failure (HF.) ranges between 20-50%,consistant with the notion that QRS prolongation become more prevalent in patients with advanced heart disease especially with Coronary Artery Disease (CAD) patients with LVEF< 30%. [3] Any combination of the BB (Bundle Block) and the fascicles may be blocked during an episode of myocardial infarction.

When QRS. duration is 120 ms or longer without the configuration of RBBB or LBBB is termed Nonspecific intraventricular conduction delay (NSIVCD. The QRS morphology in these cases is often polyphasic and bizarre and occasionally manifests splintering of the QRS complex. Such conduction defects are usually due to intramyocardial delay. [4]However, the presence of LBBB was an independent predictor of cardiovascular mortality due to SCD. [13]

It is suggested that slow conduction and the associated increase in dispersion of ventricular recovery directly promote ventricular arrhythmias. [5]

Intra-ventricular conduction delay (IVCD) or LBBB (but not RBBB.) had a 50% increase in the risk of cardiac arrest and total mortality , independent of LVEF and the results of electrophysiology (EP) testing. [6]

The prolonged QRS duration > 120-130 ms. has been shown to be associated with increased mortality in patients with reduced EF <30%. [7]

The presence and severity of underlying heart disease is the single most highly predictive risk factor for the future occurrence of SCD. [9]

In the Framingham study : pre-existing CHD was associated with a 2.8-5.3 times increase in the risk of SCD and ischemic heart failure (CHF) was associated with 2.6-6.2 times increased risk. [10]

In the same study, LVH on ECG was associated with a 2.5 times increased risk of SCD. in males, but was only a modest risk factor in females. [11]

Only 4.5% of the males classified as high risk by Risk Index (developed in the Framingham heart study), actually died suddenly over 15 years and therefore identification of those at high risk to warrant a specific intervention remains poor; this analysis is restricted to the age group 45-54 and 55-64. [12]

Aim of Study

To prove that special clinical criteria, in a sequential combination , (Male ;Structural heart disease; LV Dysfunction), can increase the predictability of sudden cardiac death (SCD), in cardiac patients.

Patients and Methods

53 consecutive patients have been studied, for whom ICD, were implanted for various indications from 9\2000 - 9\2006 at AL Khadimiah Teaching Hospital

All patients had presented with cardiac syncope; and conductive heart block (complete heart block) had been excluded clinically or by Holter monitoring (absence of episodic heart block), and Electrophysiology study (EPS.) in selected cases (especially conducted to exclude the presence of asymptomatic increased H-V interval, and to induct VT.).

Investigations included, Biochemistry, Electrolytes, 12 lead surface ECG, Echo\ Doppler study of heart, done for all patients.

All patients fulfilled class I indication (VT\ VF) for ICD implantation.

All patients had clinical VT records, of variable cycle lengths (CLs.), morphologies, and all were of LV origin.

53 patients were included in this study, 41 were males, 12 were females. All males were >40<65 years of age (mean:52 y.).while females were >46<75 years of age (mean: 60y) Those patients were subjected to testing (filtration) in a cascade pattern; starting with StHD in males with syncope; then the presence of LVS dysfunction in the previous sub-group (StHD in males with syncope); and lastly IVCD in LVS dysfunction in StHD in males with syncope. These 3 sub- groups were controlled with that corresponding sub- group which is devoid of a clinical criterion in both Pre- and Post- testing; as follows:

Sub- group I: (results are included in table II): StHD in male with syncope (Post-test\ .filtered), to be compared with StHD in whole patients (Pre- test\ unfiltered).

Sub-group II results are included in table III): LVS dysfunction in StHD in males with syncope (Post-test\ filtered),to be compared with LVS dysfunction in whole patients (Pre-test\unfiltered)

Sub- group III (results are included in table IV): IVCD. in LVS dysfunction with StHD in males with syncope (Post- test\filtered), to be compared with IVCD in whole patients (Pre-test\unfiltered).

Risk factors of SCD studied (in groups) in this series included:

1. Male >40 <65 years of age.
2.StHD including: post- MI., dilated DCM.
3.LVS dysfunction including: LVEF<40% >30%
4. IVCD >120 ms.

Each group is regarded a control group to the preceding group.

Statistical analysis:

Is based on Bays theorem (the impact of a test result on a patient probability of disease). The more simple form of this theorem is known as the Odds ratio form which describes the impact of a test result on the pre- test odds of a diagnosis or outcome for a specific patient.

To calculate the post- test odds of a disease (and hence post- test probability), pre- test odds are multiplied by the likelihood ratio (LR.)

for a specific test result, by making use of the classical 2*2 box.
Pre-test odd =probability\1-probability
LR. =Sensitivity\1-Specificity
Sensitivity= a\ a+c
Specificity= d\ b+d
Probability= odd\ 1+odd

Results

Most common ECG. findings were Q waves (either due to MI. or DCM.),while LBBB\ IVCD. were relatively uncommon (see Table I)

Table I: ECG findings in 53 patients with cardiac syncope:

Finding	Number of patient	Percentage
LBBB.	6	9.5%
IVCD.	8	10.1%
Q wave (MI. or DCM.)	35	66%
LVH.	3	5.6%
Clinical VT. recording	53	100%

Of notion, RBBB was not presented in this series, probably due to limited number of patients with IVC Defect, and the relative predominance of Ant. MI.

Most common Echo. findings were ischemic HF. (segmental hypokinesia\akinesia)- especially old anterior akinesia. (see Table II)

Table II Echo findings in 53 patients with cardiac syncope:

Finding	Number of patients.	Percentage
Ischemic HF. (segmental hypo.\ akinesia	31	58.5%
DCM/ (global hypokinesia)	16	30.2%
Old Anterior MI. (Ant. Akinesia)	27	51%
Old Inferior MI. (Inf. Akinesia)	2	O.O38%
LVH	3	5.6%

Table III Results of Pre- and Post- testing (filtering) regarding: StHD with syncope:

	Syncope with StHD	Syncope without StHD	Total
Pre-test-− group (unfiltered StHD with syncope)	45	8	53
Post-test sub group (filtered StHD. males with syncope)	34	19	53

Table IV Results of Pre- and Post- testing (filtering) regarding: LVS. Dysfunction in StHD. in males with syncope.

	Syncope with LVS dysfunction	Syncope without LVS dysfunction	Total
Pre-test subgroup (unfiltered LVS dysfunction with syncope)	40	13	53
Post-test subgroup (filtered LVS dysfunction in StHD males with syncope)	30	23	53

Table IV Results of Pre- and Post- testing (filtering) regarding: IVCD in LVS dysfunction with StHD in males with syncope:

	Syncope with IVCD	Syncope without IVCD	Total
Pre-test subgroup (unfiltered IVCD with syncope)	14	39	53
Post-test subgroup (filtered IVCD in LVS Dysfunction with StHD males and syncope)	9	44	53

Table VI Results of Pre- and Post- testing (filtering) in the 3 sub- groups:

	Males with StHD (sub group I)	Males with StHD and LVS Dysfunction (sub group II)	Males with StHD and LVS dysfunction and IVCD (sub group III)
Pre-test odd	5.66	3.08	0.359
LR	1.9	1.583	1.298
Post-test odd	10.75	4.876	0.466
Pre-test probability.	0.85	0.755	0.264
Post-test probability.	0.915	0.83	0.318
Difference in probability.	0.06	0.08	0.05
Proportional Difference (incremental) in probability.	6.47%	9.94%	20.45%

The only sub-group has significant proportional increment in probability of predicting SCD is the sub-group III (patients who have 4 combined clinical criteria: males with StHD, LVS. Dysfunction <40%>30%, and IVCD), if compared with those who have IVCD in the whole series

Discussion

To date, LVEF reduction with a threshold around <35% continues to be the easiest and most powerful predictor of both total mortality and SCD.

Prolonged QRS (> 120 ms) was a significant independent predictor of SCD (HR 2.12)

The mean age of the males in this series was 52 years (45-65 years) ,which is consistent with the pooled literature that SCD is the most common cause of IHD death in adults <65 years of age. [8]

But , unfortunately no single risk factor predict with any accuracy who will die suddenly; therefore, the ability to identify specific individual who at high risk of SCD is limited. [11]

This study aims to prove the incremental value of the presence of prolonged QRS (in a form of IVCD) as a predictor of SCD not merely by itself, but indeed by its association with the suggested clinical triplet (a male with StHD producing LVS dysfunction).

Since the StHD was the predominate abnormality in this series(45/53) ,and since males were predominant in StHD subgroup(34/45),and since LVS dysfunction was predominant in the proceeding subgroup(males with StHD)(30/34) ,and finally since the IVCD was predominant in its proceeding subgroup(males with StHD complicated by LVS dysfunction) (9/30) ; then those 9 males who suffered from StHD, LVS dysfunction with IVCD has the most predictable potentiality for SCD .(see figure I)

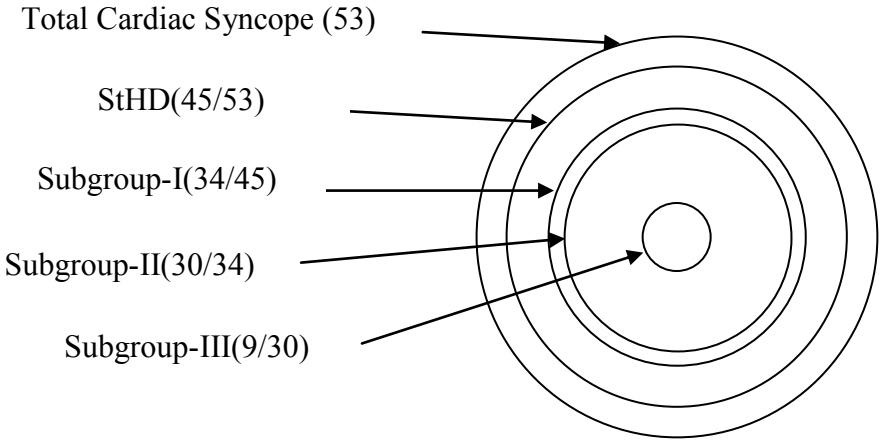

Figure I Filtration process of the risk factors of SCD (Cardiac syncope)

However, the remaining 44 patients can not be precisely predicted to be victims of SCD ,albeit they indeed suffered from aborted SCD ,indicating how relatively week is the power of such a prediction . Nevertheless, we accomplished the task of increasing this relatively week predictability from 0.264 to 0.318 (20.45% incremental probability).

The accumulated risk factors in subgroup III, give those patients the priority for ICD implantation , putting them at the top of such a list . This notion is financially important in communities with limited health local resources.

The limitations in this series include its retrospective design with its inherent inferiority to prospective one, although

conduction of such a prospective study following patient fulfilling the triplet clinical criteria of potential SCD with IVCD in their ECG is laborious with its known strategic difficulties.

The other limitation is its neglecting of female patients due to its under representation (12/53) .

One might argue that the majority of ICD recipients are over 65 years of age [14] ,which is well above the upper limit in this series (45-65), but the presented patients here represent the potential candidates for primary prevention, which we believe they form a relatively younger age group.

The issue of ICDs in patients with previous MI, poor LV function, and no prior ventricular arrhythmias was investigated in the MADIT II study which showed 30% reduction over all mortality ,and the benefit was highest in patients with prolonged QRS (>120 ms) with EF <30%.

In this series, the EF limits were30-40% which is above the upper limit of MADIT II , although they share the same issue: primary prevention of SCD.

Moreover, even in the implanted ICDs; one death is prevented for 10 patients treated over 3 years, hence the searching for markers with high predictive accuracy continues.[15]

From this limitation, the major challenge at this time is to refine our identification of patients who are likely to derive the most benefit of such an expensive therapy (eg. by taking benefit from 24 hours Holter monitoring, Signal Averaged ECG, and even invasive EPS in selected patients)

Conclusions

* 6.47% increment in the probability in predicting SCD in the presence of combined StHD and male sex; indicating no significant role of the presence of these 2 combined clinical criteria (StHD and male sex) as potential in predicting SCD (compared with the presence of StHD alone in whole series)

* 9.94%increment in probability in predicting SCD in the presence of LVS dysfunction <40% >30% with StHD in males; indicating no significant role of the presence of combined 3 clinical criteria (LVS dysfunction, StHD and male sex) potential in predicting SCD (compared with the presence of LVEF,<40% >30% alone LVD dysfunction in patient with StHD males

* 20.45%increment in the probability in predicting SCD in the presence of combined IVCD, LVS dysfunction, (LVEF<40%>30%), StHD, and male sex ; indicating a significant role of the presence of these combined 4 clinical criteria (IVCD, and LVEF<40%>30%, StHD, and male sex) , as potential predictors of SCD**.**

Recommendations

Although the presence of 4 clinical criteria in a patient presenting with SCD is a relatively uncommon: 9\30 (%), the presence of IVCD in a male patient >40<65 years of age who had StHD and LVEF<40%>30%, is associated with higher probability of SCD; neccessating close and watchful surveillance. However, the management strategy still of current debate internationally.

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