Implantable Cardioverter-Defibrillator

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ARTICLE INFO	ABSTRACT
Published Online: 08 September 2020 Corresponding Author: **Salwa Cheraou**	**Introduction**: Sudden cardiac death (SCD) is a public health problem with an incidence of 3 million worldwide. In most cases, it is secondary to heart rhythm disturbances of ventricular origin. The only treatment with proven efficacy is the implantation of an implantable cardioverter-defibrillator (ICD). **Materials and methods**: We report a retrospective and descriptive study comprising 13 patients implanted with an ICD in our department and collected between 2010 and 2019. **Results**: The average age of the patients is 44 years with a predominance of men. The distribution of etiologies shows a clear predominance of genetic heart disease. The symptomatology at implantation was mainly palpitations. 46% of patients in the series are implanted prophylactically. The single-chamber DAI is the most established (53.8%). **Conclusion:** Our study first confirmed that ICD saves lives. It is the standard treatment for ventricular rhythm disorders, both in primary and secondary prevention of sudden death. At the B cardiology department of the Rabat University Hospital, the general characteristics of the population studied are similar to those described in the literature with regard to the indications for implantation and patient follow-up are respected.
KEYWORDS: ICD, Sudden death, VT, VF	

I. INTRODUCTION:

Sudden cardiac death (SCD) is a public health problem with an incidence of 3 million worldwide. In most cases, it is secondary to heart rhythm disturbances of ventricular origin. The only treatment with proven efficacy is the implantation of an implantable cardioverter-defibrillator (ICD).

Numerous studies have demonstrated the benefit of ICD on survival, which has led to an increase in its indications. Increasingly sophisticated thanks to technological advances, the device is in constant development. Capable of reducing arrhythmias by anti-tachycardia pacing, it features increasingly complex discrimination algorithms and large memory. The miniaturization of the case simplifies the implantation procedures.

Technological advances have been and still are very rapid in this field. Initially, the implementation consisted of the establishment of a patch electrode located at the apex of the heart requiring a surgical approach and an imposing body in the abdominal position. Currently, thanks in particular when biphasic waves appear, only an endovenous approach with pectoral implantation of a miniaturized case is performed, decreasing considerably perioperative mortality.

Alongside these technical advances, prevention studies secondary as well as primary have multiplied, confirming the importance that implantable defibrillation systems take in the treatment of serious ventricular arrhythmias, and confirming or even affirming their superiority to alongside other therapies such as drug treatments used alone, antiarrhythmic surgery and heart transplantation. By means of a retrospective and descriptive study on a series of patients implanted with these ICD at the IBN SINA RABAT hospital center - Cardiology Department B- we wished to analyze the characteristics and fate of patients benefiting from this technique. The primary objective of this study was to describe the implanted population. The secondary objectives were to study the long and medium term follow-up of these patients.

II. MATERIALS AND METHODS

We report a retrospective and descriptive study comprising 13 patients implanted with an ICD in our department and collected between 2010 and 2019. A retrospective study was carried out at the Rabat University Hospital. All patients

implanted with an ICD for ischemic or dilated heart disease for primary prevention were included. The factors studied were collected at implantation and during follow-up consultations.

A- Type of study:

This is a descriptive retrospective study of patients who benefited from the implantation of an ICD in the B cardiology department of the Ibn Sina hospital center in Rabat during the study period.

B- Inclusion and exclusion criteria / Study period

1. Inclusion criteria:

All patients regardless of age, implanted with an ICD, whether it is a first implantation or a change of case, in the B cardiology department of the Ibn Sina University Hospital in Rabat.

2. Exclusion criteria:

Patients implanted in another center

3. Study period:

Inclusion period: between January 2010 and December 2019

C- Criteria studied:

- Patient: name, first name, age and sex
- Age of the patient at the time of the first implantation
- Year of first implantation and possible date (s) other (s) Location (s) in year between 2010 and 2019
- If applicable, presence of a first implantation prior to 2010
- Total number of implantation (s) per patient
- Brand (s) of the ICD (s): Medtronic, Biotronik, Saint Jude, ELA Sorin or Boston guiding
- Type of ICD: single, double or triple room
- Underlying heart disease: ischemic heart disease, dilated cardiomyopathy (DCM), arrhythmogenic right ventricular dysplasia (ARVD), brugada syndrome, congenital long QT syndrome, hypertrophic cardiomyopathy(HCM) , other heart disease (including valve disease, healthy heart) and unknown heart disease
- Ejection fraction (EF) of the left ventricle: by ultrasound or magnetic resonance method
- Anti-arrhythmic treatment at implantation: amiodarone, beta-blocker, beta-blocker and amiodarone or flecaine.
- History of atrial fibrillation (AF)
- Symptoms preceding implantation: syncope, malaise, cardio-circulatory arrest, palpitation, angina, heart failure or absence of symptoms
- Type of rhythm disorder identified before implantation: Ventricular tachycardia (VT), ventricular fibrillation (VF), ventricular extrasystole (VES) or absence of rhythmic disorder identified
- Use of programmed ventricular pacing and result
- Consultation:
  + Total number of consultations during the follow-up period
  + Number of urgent consultations
  + Etiology of urgent consultations: shock of the ICD, emission of an alarm by the device and complication
- Hospitalizations:
  +Total number of hospitalizations during the follow-up period
  + Hospitalization for rhythmic problem with appropriate ICD therapy
  + Hospitalization for rhythmic problem with inappropriate ICD therapy
  + Hospitalization for heart failure
  + Hospitalization for other problem and etiology
- Number of shock (s) delivered by the device
  +Appropriate number of shock (s)
  + Inappropriate number of shock (s)
  +Etiology of inappropriate shocks: supra-ventricular tachycardia (SVT), parasite, over-detection, lead rupture
- Occurrence of rhythmic storm (s)
- Complication:
  + Presence of complication
  + Type of complication: inappropriate shock, displacement of the probe, exteriorization of the case, infection, endocarditis, pneumothorax, hematoma, rupture of the probe, insulation rupture, phrenic stimulation, device dysfunction, premature wear and thrombosis
- NYHA class: I to IV
- History of coronary artery bypass grafting (CAP) and angioplasty in the subpopulation of patients with ischemic heart disease
- VT ablation
- Ablation of the atrioventricular node
- Complications associated with long-term treatment with amiodarone:
  + Hyperthyroidism
  + Photosensitization
  + Pneumopathy
- Death and etiology of death: rhythmic cause, heart failure, other unknown etiology or etiology.

D- Data collection:

To use a list of patients, we used the database specific to the rhythmology department. It collects the names, first names, dates of birth, years of implantation, implantation reports and follow-up dates of patients.

The clinical data were collected by consulting the archived medical files of the cardiology department B of the University Hospital of Rabat.

The EXCEL software made it possible to create the database.

III. RESULTS

A- Study population

Between 2010 and 2019, 13 patients with an ICD were followed in the B cardiology department of the Rabat University Hospital.

1 .General characteristics:

1a. Age and gender

The average age of patients at the time of implantation is 44 years with a minimum age of 12 years and maximum of 69 years.

There is a clear male predominance with a sex ratio of 5.5 (11 men for 2 women).

1b. Underlying heart disease:

In the study population, there is a clear majority of arrhythmogenic RV dysplasia (ARVD) with 5 patients (38%). 3 patients (23%) with hypertrophic cardiomyopathy including amyloidosis (HCM) and 2 patients (15%) with ischemic heart disease in the dilated stage. Primary dilated cardiomyopathy is found in 1 patient (7%) and 1 patient (7%) has congenital long QT syndrome. One patient (7%) presented with Brugada syndrome. No other etiology has been identified, in particular: valvular heart disease, cardiac arrests and symptomatic VT without found heart disease, aortic pathologies (dissection and aneurysm of the ascending aorta)

1 C. Age of implantation and heart disease:

The average age for implantation in ARVD is 42.4 years. In HCM, patients with an average age of 57 years. The two patients with dilated ischemic heart disease are 41 years old. The child with Jervelle and Lang Nielson syndrome is 12 years old. The patient implanted for Brugada syndrome is 56 years old while the patient with primary DCM is 44 years old.

1d. Coronary artery bypass grafting and angioplasty

Both patients in the ischemic heart disease subgroup underwent myocardial revascularization prior to implantation. One case received CAP and the second received dilation with placement of an active stent on the anterior interventricular artery proximal.

2. LV systolic function:

46% of patients implanted with an ICD have a retained EF between 50% and 69% 53% of patients have an impaired EF of which 57% have a very (less than 30%) EF. The EF measurements retained were obtained without distinction between ultrasound method and by magnetic reasonance imaging. The analysis of this result shows that patients labeled genetic heart disease (Brugada syndrome, ARVD, HCM and congenital long QT composed of 10 patients) have an EF greater than 50% in the majority of cases (60% of patients with this under group) unlike the DCM and ischemic heart disease groups which have LVEFs of less than 50% in 100% of cases.

3. NYHA Stadium:

In the general population of implanted patients regardless of the underlying heart disease, 8 patients (61.5%) present with dyspnea, 1 patient (12%) are NYHA stage II and 7 (87%) stage III and IV.

This distribution in our series does not differ according to the causal heart disease. Patients with ischemic heart disease in the dilated stage and primary CMD are all stage III or IV. In patients with a genetic heart disease, 40% of patients are symptomatic with stage III or IV NYHA: these were two patients with ARVD and two patients with HCM.3 patients benefited from the implantation of a multisite ICD. All were in class III and IV of the NHYA.

4. Symptomatology at implantation:

4a. In the study population regardless of heart disease.The most frequently encountered symptomatology at implantation is the occurrence of palpitation (61% of cases). 15% of the patients presented with syncope, 15% presented with dyspnea and 7% had recovered cardiac arrest Symptoms are different depending on the etiology of the heart disease.

4b. In the ARVD :

The patients with ARVD all presented isolated palpitations with no other associated symptoms.4c. In ischemic heart disease in the dilated stage;

In patients with ischemic heart disease in the dilated stage, dyspnea is the main symptom.

4d. In HCM / Jervell lang and Nielson syndrome and Brugada syndrome:

Syncope is the main initial symptom (80%). The rate of cardiac arrest is low. This figure corresponds to a single patient with Brugada syndrome.

5. Inaugural rhythmic disorder

5a. Ventricular rhythm disorder

The ventricular rhythm disturbances identified before ICD implantation were severe ventricular rhythm disturbances (VT) in the vast majority of cases (46%).

In 23% of patients, no ventricular rhythm disorder was diagnosed prior to device implantation.

The inaugural arrhythmias differ depending on the causative heart disease. VT is common in ARVD, HCM, and Brugada syndrome. VT is the most common rhythm disorder in all three groups.

The distribution of rhythmic disorders according to heart disease is detailed in the table –

Table 1: Distribution of arrhythmias according to heart disease.

	Number of patients	SVT	VT nonsustained	Ventricular ES IVb of Lown	Other disorder
ARVD	5	4 (80%)	1 (20%)	0	0
HCM	3	1 (33%)	1 (33%)	1 (33%)	0
Ischemic heart diseas at the dilated stage	2	0	0	0	0

Primitive DCM	1	0	0	1	0
Brugada syndrome	1	1	0	0	0
Jervell Nielson syndrome	1	0	0	0	long QT

5b. Practice of programmed ventricular pacing Only one patient in the series received programmed ventricular pacing. She came back negative.

5c. Prevalence of atrial fibrillation At implantation, 23% of patients have a history of permanent or paroxysmal AF. 2 cases have ARVD and one patient with HCM.

6. Anti-arrhythmic treatment at implantation
Among the patients studied, only one patient (7%) did not have antiarrhythmic treatment at the time of implantation. This is the patient with Brugada syndrome. Among the patients under treatment: 7 patients (58.3%) are on beta-blockers alone; 4 patients (33.3%) benefit from an amiodarone-beta blocker combination, and 1 patient (8.3%) are treated with flecainide.

The patient on flecainide presents: a ARVD with retained LVEF. 3 patients treated with amiodarone present complications attributed to the treatment: 2 cases have hyperthyroidism and one patient has photosensitization syndrome.

B- Locations
1. Implantation rate
In total, between 2010 and 2019, 15 implantations were performed in the cardiology department B of the Rabat University Hospital in 13 patients. 84% of patients received a single ICD implantation, 15% of patients had a case change and therefore two implants. The number of implantations has continued to increase over the years

2. The brands of DAI:
This data was used in only 7 patients. The Medtronic brand is the most frequently used, accounting for 71% of the establishments against 14% for Saint jude and 14% for Boston Guidant.

3. The different types of ICD (single, double and triple chamber) In the study, 7 patients (53.8%) were implanted by a single chamber ICD, 3 patients (23%) by a double chamber and 3 patients (23%) by a multi-site ICD.

The implementation of a multi-site was of interest to patients with ischemic heart disease in the dilated stage and one patient with cardiac amyloidosis.
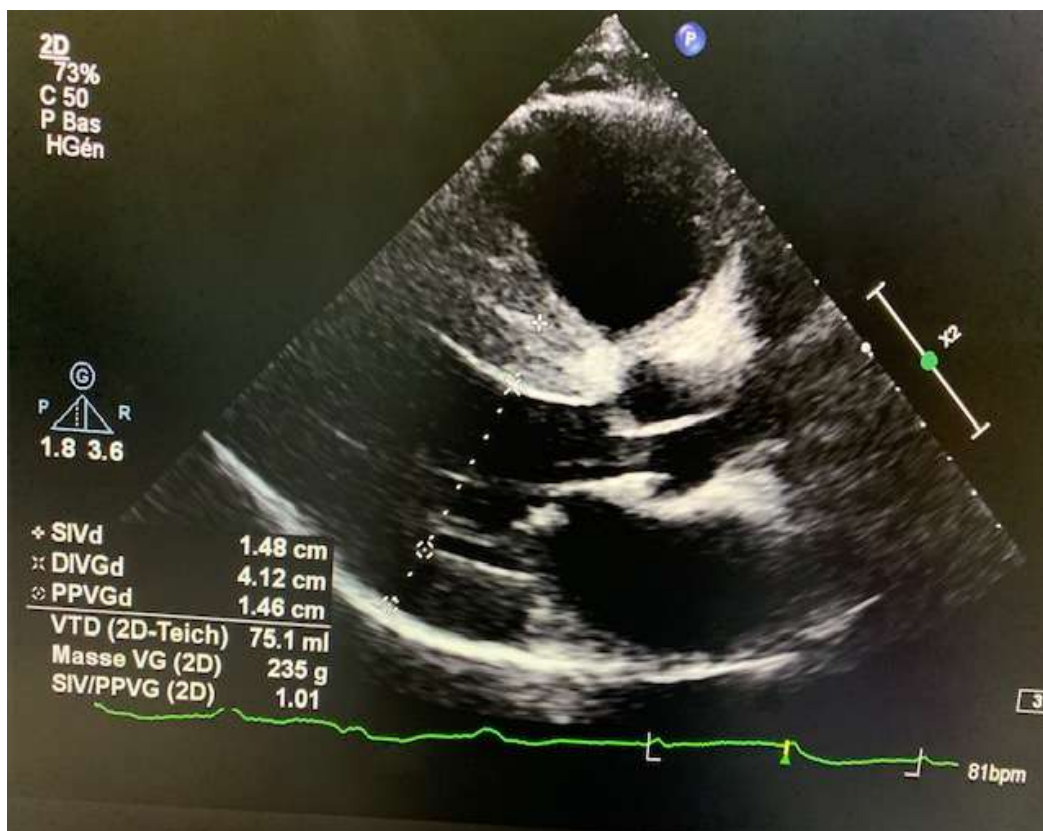
Figure 1: Long-axis parasternal trans-thoracic echography section of the patient with cardiac amyloidosis objectifying hypertrophic cardiomyopathy with a scintillating appearance of the myocardium
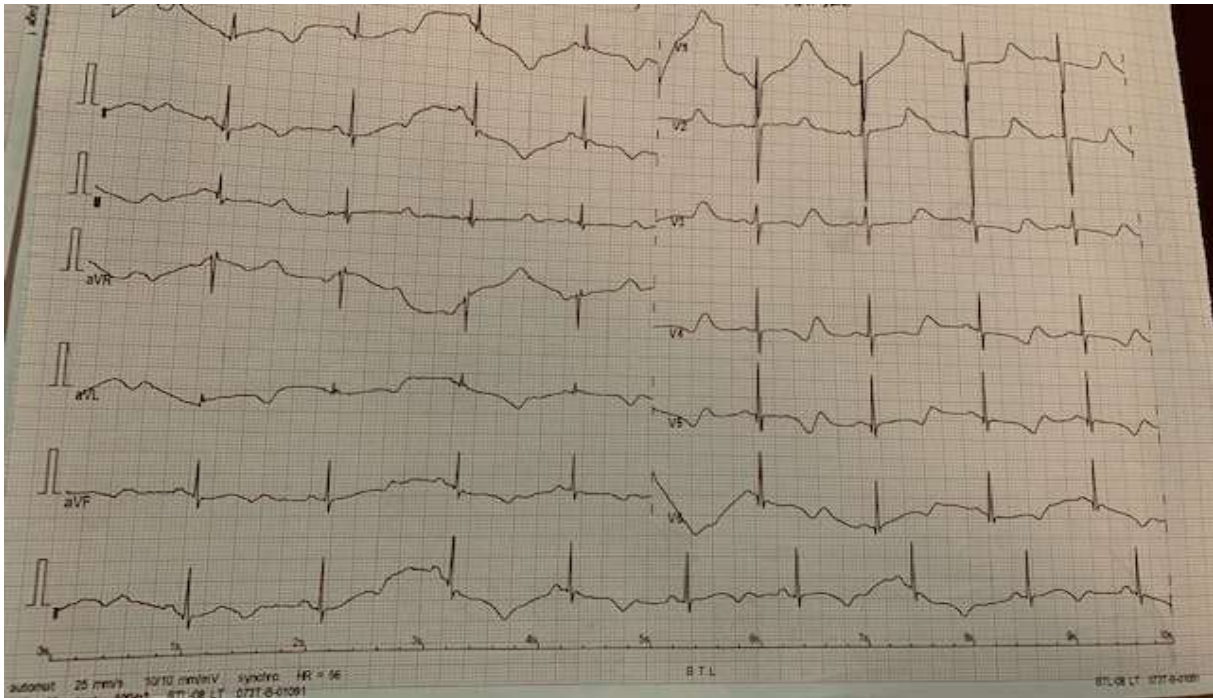
Figure 2: Pathognomonic ECG of long QT syndrome with a QTc measured at 680ms in a child with Jervell and Lange Nielson syndrome
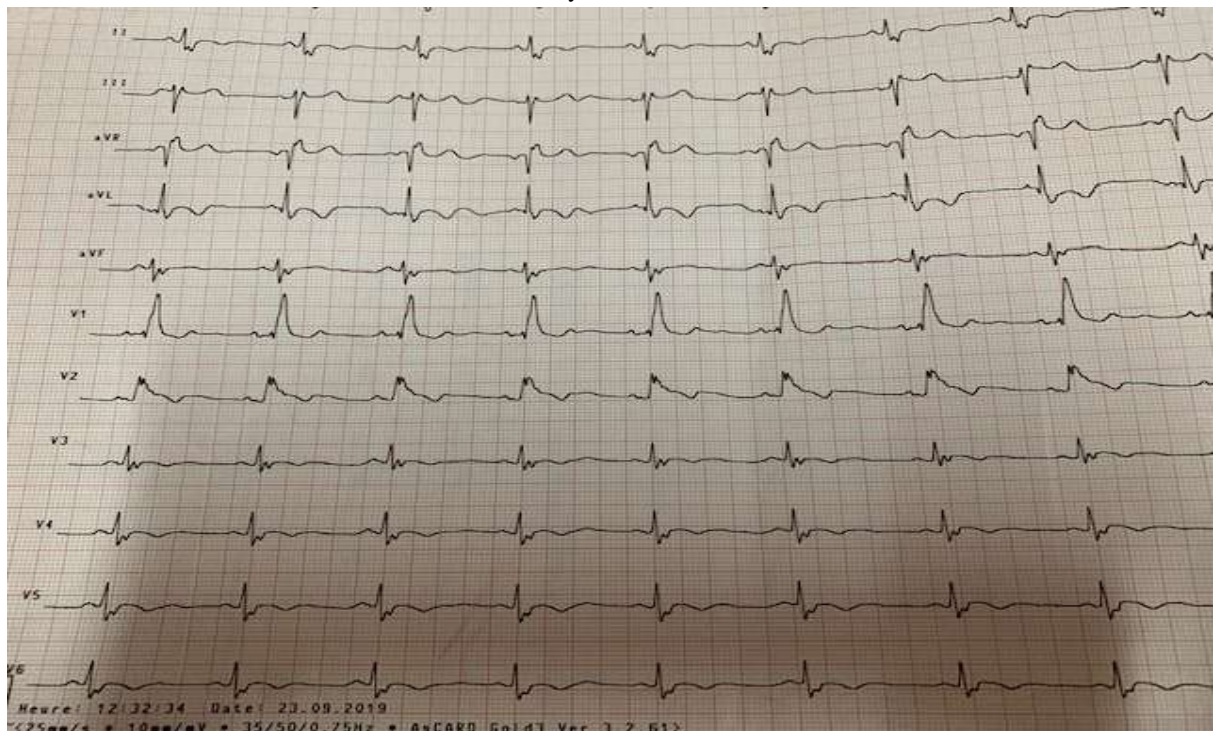
Figure 3: ECG appearance in favor of Brugada syndrome with right block branch bundle, ST segment elevation and negative T waves from a patient in the series

C- Appropriate therapies:

Appropriate shocks

1. Number of lives saved During follow-up, one patient (7%) received an internal electric shock from a serious and potentially fatal ventricular rhythm disorder. By extrapolation, we can consider that this patient was "saved" by his implantable automatic defibrillator. This patient has a ARVD. In addition, several episodes were effectively stopped by anti-tachycardial stimulation without resorting to shock.

2. Appropriate number of shocks In total only one appropriate shock was delivered to the above-mentioned patient.

D- Monitoring of the implanted patient

1. Hospitalizations

During the follow-up of 13 patients, 18 hospitalizations were recorded and which involved 9 patients:

• 6 hospitalizations for a rhythmic problem with normal operation of the device. Rhythmic thunderstorm was diagnosed in 3 patients.

• Hospitalization for a problem of electric shocks delivered by the device inappropriately.

• 8 hospitalizations for problems other than those mentioned above.

- 2 changes of ICD case
- 2 acute coronary syndromes without elevation of the ST segment
- Externalization of the material
- Infectious endocarditis
- Urinary tract infection
- Exploration of syncope

• In the study period, heart failure was also a responsible cause of hospitalization. In fact, 3 patients are hospitalized.

2. Consultations

In total, over the study period, 60 consultations were performed in 13 patients. The average consultation per person is 4.6.

12 consultations (20%) are carried out as an emergency against 48 (80%) as part of the usual follow-up.

3. Complications

Out of the initial population of 13 patients, 5 patients presented one or more complications, ie 38% of the patients implanted.

• Probe fracture

The patient with Jervell Nielson Syndrome had inappropriate shocks on broken probe

• Pneumothorax:

Two patients presented with favorable progressing pneumothorax requiring thoracic drainage in both cases.

• Hematomas

One patient had a hematoma which progressed favorably without requiring evacuation.

• Infectious complications.

They occurred in 2 patients.

An externalization of the material in connection with an infection of the compartment.

In one patient the compartment infection progressed unfavorably with a picture of endocarditis.

4. Deaths

No deaths were noted in the study population during the follow-up period

IV. DISCUSSION

A- Characteristics of the population and indication of location:

The general characteristics of the population of patients implanted in the cardiology department B of the University Hospital of Rabat are comparable to those of the literature [1,2,3,4,5,6,7,8,9,10]. There is a clear majority of men with a sex ratio of 5.5 or 84% of the entire population studied. Data from the French EVADEF registry, relating to the 24-month follow-up of 2418 implanted patients [11], show a sex ratio of 6.2 with 86% implantation in male patients.

The patients followed in the cardiology department B are significantly younger at the time of their first implantation compared to the patients described in the other series. The mean age is 44 years compared to 60 years in the EVADEF register [11], and 58 years in a series of 202 patients reported by A.Tisseau in Tours [1].

The distributieon of the etiologies of the heart disease of the patients implanted in our series is different from that of the literature with a clear prdominance of genetic heart disease whereas in the other series it was ischemic heart disease which represents 60% of implantations [1,7 , 13].

Regarding the symptomatology at implantation, we find a low rate of patients implanted following a recovered cardiac arrest (only one case of Brugada).

This rate could be explained by the small number of patients included in the study compared with the series described in the literature and due to the problem of unavailable management.

Palpitations represent the most frequent symptomatology, this symptom is correlated with the nature of the predominant heart diseases in our series.

It is interesting to underline the clear progression of implantations in primary prevention during the follow-up period. This increase is more marked from 2017. In our study, 46% of patients are implanted prophylactically. In A. Tisseau's study the rate was 28.2% [1]. A study published in 2017, the main objectives of which were to describe the evolution of the number of defibrillator installation and the valuation of these stays between 2011 and 2016 [13] showed that in 2016, 256 ICD were installed including 35.2 % single room, 16.8% double room and 48% triple room.

In our series, the single-chamber ICD was the most established with a rate of 53.8% followed by the double chamber and the triple chamber with 23% each.

We see an increase in the percentage of triple chamber in the literature compared to our population. This is caused by a lack of means but not by a lack of indication. The use of the B cardiology service database has made it possible to identify a large number of patients with indication of a triple-chamber ICD which has not been set up; lack of means.

Regarding the drug treatment of patients followed in the cardiology department B, all patients with ischemic heart disease or patients with DMC benefit from a beta-blocker treatment at the time of implantation of their defibrillator. , which corresponds to the data in the literature [12].

The indications for implantation in the cardiology department B appear to comply with the most recent recommendations published in 2012 [14].

B- Effectiveness of DAI on mortality: number of lives saved

Among 13 patients, 1 appropriate shock was delivered during the study period in 1 patient, due to a severe ventricular rhythm disturbance. The defibrillator therefore saved the lives of 7% of the implanted patients. Larger figures are mentioned in the literature [15,2,8,12,16]. We can relate this modest

figure to the small number of patients included in our series compared to those collected in the other series described in the literature.

C- Complication and death

The overall complication rate in our series is 38%, which is comparable to the data in the literature where complications occur in 13.8% to 36.7% of implanted patients [1,11,17,18]. The studies show lower complication rates, in particular the work of F. Tsai, published in February 2009, which shows a complication rate of 5.7% in a series of 1060 patients with an average follow-up of 38 months [19]. This difference can be explained by the fact that this is a prospective study with ICDs that have evolved from the old models. In addition, the follow-up period is short.

The most frequent complication in the literature is the occurrence of inappropriate shocks. They occur in 10 to 36% of patients [1,12,15,17,18,20 18,21].

In our study population, only one patient experienced inappropriate shocks.

In the literature, several predictive factors for the onset of inappropriate shocks are mentioned such as younger age [18], smoking, hypertension [21] and atrial fibrillation. The patient in question is 13 years old with Jervelle Nielson syndrome. In our zero series complications were dominant. So the study of predictors was not possible.

In the EVADEF registry, the causes of death were: heart failure in 42% of cases and 6.2% are from rhythmic causes [11]. Similar figures are found in other studies [9,22,23,24,25,26].

In our series no deaths were reported.

D. Improving patient care: Therapeutic education

In our series, heart failure is responsible for 30% of hospitalizations and shock is responsible for 15% of hospitalizations.

In parallel with the technological advances specific to the ICD, the overall care of the patient has evolved throughout the study period with a major role in therapeutic education.

It is essential to inform the patient on the principle of operation of the ICD and on what to do in the event of shock, which constitutes an anxiety-provoking situation. Studies relating to the quality of life of implanted patients find that after a certain period of adaptation to the ICD, patients do not experience any handicap related to the presence of their defibrillator [27,28,29].

In patients with heart failure, therapeutic education is particularly important.

V- CONCLUSION

Our study first confirmed that ICD saves lives. It is the standard treatment for ventricular rhythm disorders, both in primary and secondary prevention of sudden death. The decision to implant an ICD is difficult to make because the risk of complications is not negligible. Inappropriate shocks are the most common complication and encourage particular attention to programming modalities and use of tachycardia

discrimination algorithms. At the B cardiology department of the Rabat University Hospital, the general characteristics of the population studied are similar to those described in the literature with regard to the indications for implantation and patient follow-up are respected. There has been an increase in the number of implantations over the years. Optimal programming and therapeutic education are fundamental for good care. The telemonitoring examinations will undoubtedly make it possible, in the near future, to further optimize the quality of life of the implanted patient.

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