Původní sdělení | Original research article

Prevalence and predictors of pacemaker dependency: Data from a cardiac centre registry in Iraq

Haitham Ali Abdullah, Ali Al-Mossawi, Kasim Abbas Ismail Al-Iqabby

Ibn Al-Bitar Cardiac Centre, Baghdad, Iraq

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SOUHRN

Kontext: Závislost na kardiostimulátoru, kterou lze obecně definovat jako důsledek nedostatečného nebo chybějícího intrinsického pacientova srdečního rytmu, může mít nebezpečné následky při poruchách rytmu, jež mohou ovlivnit fungování kardiostimulátoru.
Cíle: Zjistit prevalenci závislosti na kardiostimulátoru u pacientů s trvalým kardiostimulátorem a analyzovat jednotlivé faktory, které mohou vznik závislosti ovlivnit. Dělení pacientů na ty se závislostí versus bez závislosti na kardiostimulátoru významně ovlivňuje jejich léčbu.
Pacienti a metoda: Do průřezové studie bylo zařazeno 400 pacientů s trvalým kardiostimulátorem pro různé bradyarytmické poruchy. Pacienti docházeli v rámci sledování od listopadu 2013 do srpna 2014 na specializované kardiochirurgické pracoviště Ibn Al-Bitar Specialized Center. Vyšetření případné závislosti na kardiostimulátoru se provádělo snížením základní stimulované frekvence na 30 tepů/min, přičemž se současně pozorně sledovala přítomnost intrinsického rytmu i rozvoj symptomů souvisejících s tzv. underpacingem. Všechny údaje potřebné pro náš výzkum se získávaly prostřednictvím dotazníku, programování a předchozích údajů o pacientovi.
Závěr: Závislost na kardiostimulátoru byla zjištěna u 17 % zařazených pacientů. Nejvýznamnějšími proměnnými ovlivňujícími incidenci závislosti byly základní rytmus před implantací a celková doba stimulace. Demografické charakteristiky pacientů se závislostí na kardiostimulátoru nesouvisely. Nebyl ani prokázán žádný vztah mezi závislostí na kardiostimulátoru a způsobem stimulace, režimem frekvenčně reagující stimulace, případně dobou od implantace.

Keywords:
Bradyarrythmia
Intrinsic rhythm
Pacemaker dependency
Pacing
Underlying rhythm

ABSTRACT

Background: Pacemaker dependency can be defined generally as inadequate or absent patient intrinsic rhythm, it has a dangerous consequence during conditions that may affect pacemaker function.
Objectives: To identify the prevalence of pacemaker dependency among patients with permanent pacemaker and to analyze the particular factors that may affect its occurrence. Grouping the patients to pacemaker dependent or not has a great effect on patient management.
Patients and method: A cross-sectional study enrolled 400 patients with permanent pacemaker for different bradyarrhythmia abnormalities. Patients visited Ibn Al-Bitar Specialized Center for cardiac surgery from November 2013 to August 2014 as a part of their follow up programming. The test for pacemaker dependency was performed by decreasing the base paced rate to 30 bpm with close observation to the presence of intrinsic rhythm as well as development of symptoms related to under pacing. All data needed for our research were obtained via questionnaire, programming, and patient previous data.
Conclusion: Pacemaker dependency was identified in 17% of the enrolled patients. The underlying rhythm before implantation and the total time of pacing were the most important variables that affect the incidence of dependency. Patients' demographic characteristics were not associated with pacemaker dependency. Mode of pacing, rate adaptive mode, and time since pacemaker implantation were not found to be associated with pacemaker dependency.

Address: Haitham Ali Abdullah, Ibn Al-Bitar Cardiac Centre, Baghdad, Iraq, e-mail: haithamcardio79@gmail.com
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Introduction

The incidence of pacemaker dependency is variable and depends on the definition and testing technique. There are differences in the protocols in terms of the lower basic pacing rate during the test, the gradual or not reduction of the rate of ventricular pacing, the duration of the test, and the evaluation of symptoms apart from the presence or absence of an escape rhythm. Of note, current protocols do not usually apply a complete cessation of back-up pacing for some time period.[1] The latter process was very common in the past when external programmability by telemetry was unavailable. Moreover, the particular practice of each country regarding PM implantation indications significantly affects the incidence of pacemaker dependency. For example, in poor countries with very poor resources and no cover of the costs by a national insurance, the pacemaker dependency incidence would be very high since only very symptomatic patients with advanced bradyarrhythmia disorders would have been implanted a PPM.[2] The incidence of long-term pacemaker dependency depends mainly on the underlying bradyarrhythmic abnormality. It is well known that patients with high-grade AV block become pacemaker dependent more frequently than those with sick sinus syndrome (SND).[1,3,4]

Pacemaker dependency becomes a very important topic recently especially being complicating many advanced cardiac procedures that necessitated PPM implantation.[5]

We aimed in this study to identify the prevalence of pacemaker dependency and the particular variables that may affect its occurrence. Grouping the patients to pacemaker dependent or not may affect the decision regarding the frequency of follow up, and bring the attention to the conditions that may affect the pacemaker function which could be life-threating in pacemaker-dependent patients.

Patients and methods

Study design and setting: This cross-sectional study was conducted on 400 patients who attended Ibn AL-Bitar Specialized Center For Cardiac Surgery between the period from November 2013 to August 2014.

Patients: All the eligible patients had permanent pacemakers.

Data collection: The indication and decision of implantation were undertaken previously by interventional cardiologists nearly in all patients.

A questionnaire was designated to evaluate the patients which includes patient name, age, gender, date of the implantation of the pacemaker, mode of pacing and whether programmed to rate adaptive or note and the percent of total ventricular pacing was achieved during pacemaker programming.

The underlying rhythm abnormality that necessitates pacemaker implantation was identified by pacemaker card in most of the patients, recalling patients' medical records from the hospital archive or during programming by disclosing underlying rhythm if it was possible.

Definition: We consider the patient is pacemaker-dependent if there was absence of native ventricular rhythm when pacing was programmed down to 30 bpm or when symptoms related to under pacing were developed.

Device assessment: The method of programming was as routinely done with addition of the test for pacemaker dependency, during the test any symptom related to bradycardia was registered which include light headedness, dizziness, presyncope, syncope shortness of breath. All mode of pacemaker was turned to VVI. Patient rhythm is monitored by exposing programmer EGM with the annotations. The rate of pacing is gradually decreased to 30 bpm with close observation to the underlying intrinsic ventricular rhythm as well as recording of patient's symptoms. If native rhythm didn't appear 5 seconds after reaching the pacing rate of 30 bpm or any significant symptom of bradycardia was developed the pacing was turned to original setting and patients were considered pacemaker-dependent.

If any continuous native rhythm appeared during this period (from original programmed rate down to 30 bpm) or the patient was totally asymptomatic, the patient was not considered pacemaker-dependent. Patients who have their native rhythm above the basic paced rate didn't undergo the test for the pacemaker dependency.

Data analysis: SPSS V.20 (Statistical Package for the Social Sciences version 20) was used for data input and analysis. The Chi-square (χ^2) test was used but when one of the expected values was less than 5, Fisher exact test or Mid-*p* exact test was used to calculate *p*-value. Correlation between continuous variable was assessed using ANNOVA test. Significant *p*-value was <0.05.

Ethical approval and patient consent: Ethical approval for this study was obtained from the Arab Board of Health Specializations and Ibn Al-Bitar Cardiac Centre. Informed consent was obtained from each patient to participate.

Results

400 patients were enrolled in the study. 219 (54.8%) were males and 181 (45.2%) were females, the mean age ± SD was 54±20.4 years, the youngest patient was 18 months old and the oldest one was 89 years old.

The pacemakers that were implanted for the studied patient were: VVI in 199 patients, VDD in 76, DDD in 124 patients, and AAI in one patient (Fig. 1).

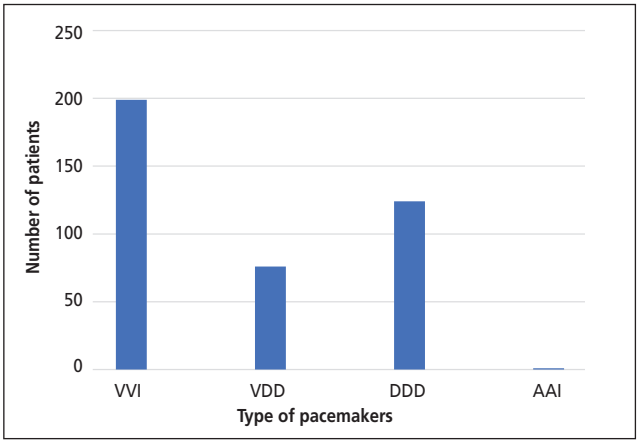

Fig. 1 – Type of pacemakers

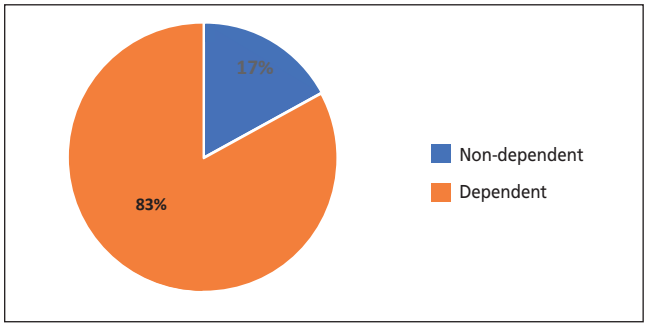

Fig. 2 – The prevalence of pacemaker dependency

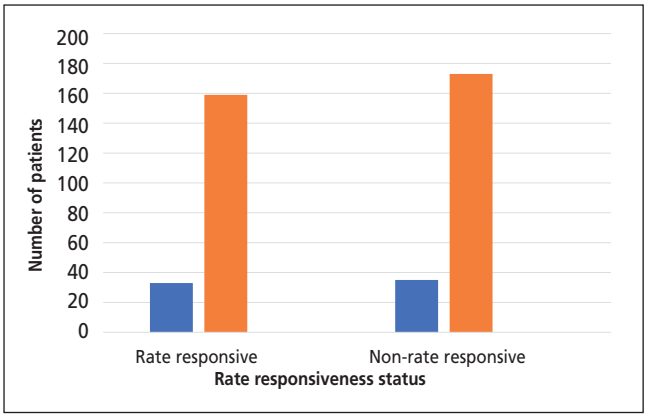

Fig. 3 – Relation between rate responsiveness and dependency

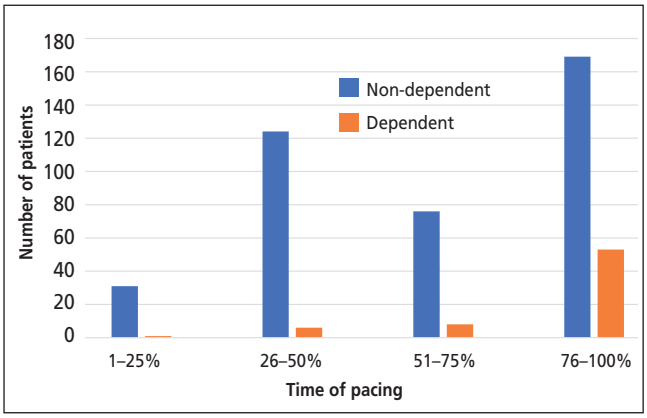

Fig. 4 – Relation of time of pacing with dependency

The overall prevalence of pacemaker dependency among all studied patients was 17% (Fig. 2).

The relation between age and dependency was statistically not significant. See Table 1.

30 (16.5%) of 181 female patients were pacemaker-dependent, 38 (17.3%) of 219 males were dependent the relation between gender and dependency was not significant (Table 2).

The pacemakers of 192 patients were programmed to rate response mode 33 (17.1%) of them were pacemaker-dependent, the remaining 208 were not set to rate responsive and 35 (16.8%) of them were pacemaker dependent, the relation was not significant (p-value = 0.9) (Fig. 3).

The relation between the time elapsed since pacemaker implantation and dependency was not statistically significant, Table 3 illustrates the distribution according to time since implantation.

Table 1 – The relation between age and dependency

Age (yrs)	The dependent	Non--dependent	Total	p-value
<30	9	52	61	0.78
30–60	15	78	93	
>60	44	202	246	
Total	68	332	400	

Table 2 – Relation between gender and pacemaker dependency

Gender	Dependent (%)	Non--dependent	Total	p-value
Female	30 (16.5)	151	181	0.85
Male	38 (17.3)	181	219	
Total	68	332	400	

Table 3 – Time since implant vs. dependency

Time since implant	Dependent (%)	Non--dependent	Total	p-value
1–5 years	38 (14.8)	218 (85.2)	256	0.09
6–10 years	27 (21.4)	99 (78.6)	126	
≥10 years	3 (16.6)	15 (83.4)	18	
Total	68	332	400	

Table 4 – Relation between type of pacemaker and dependency

Type of pacemaker	Dependent (%)	Non--dependent (%)	Total
VVI	29 (14.5%)	170 (85.5)	199
VDD	17 (22.3%)	59 (77.7)	76
DDD	22 (17.7%)	102 (82.3)	124
AAI	0	1	1
Total	68	332	400

14.5% of patients with VVI pacemakers were dependent, 22.3% of patient with VDD pacemakers were dependent and 17.7 % of DDD patients were dependent, this difference was statistically non-significant (p-value = 0.4) (Table 4).

The percentage of pacing which reflects total time at which the patient was being paced was significantly associated with pacemaker dependency (p-value = 0.001) (Fig. 4).

In the analysis of underlying rhythm abnormalities and their relation with pacemaker dependency (Table 5), 221 patients have AV nodal block (which include CHB and 2nd degree block) of them 26.6% were pacemaker dependent, 21 patients have sinus Bradycardia (9.5% were dependent), 62 patients have tachy-brady presentation (3.2% were dependent), 36 patients with long pause (5.5% were dependent), 13 patients have sinus arrest or exit block (7.2% were dependent), 22 patients with atrial fibrillation and slow ventricular response (9% were de-

Table 5 – Underlying rhythm vs dependency cross tabulation

Underlying rhythm	Dependent (%)	Not dependent	Total
AVB	59 (26.6)	162	221
Sinus bradycardia	2 (9.5)	19	21
Long pause	2 (5.5)	34	36
Tachy-brady	2 (3.2)	60	62
Sinus arrest or block	1 (7.2)	12	13
Bifascicular block	0 (0)	4	4
Af + slow V. response	2 (9)	20	22
Chronotropic incompetence	0 (0)	3	3
Uncertain	0 (0)	18	18
Total	68	332	400

pendent), 4 patients with fascicular block or alternating bundle branch block, 3 patients with chronotropic incompetence, and in 18 patients the underlying rhythm was uncertain (no one of them were dependent). Pacemaker dependency was more common in patients with AVB.

Discussion

Up to our knowledge there is no reported data from Iraq regarding pacemaker dependency. Permanent cardiac pacing is the treatment of choice for irreversible and symptomatic bradycardic abnormalities. The issue of pacemaker dependency is complex and actually there is a great diversity of definitions in the available literature, and by reviewing the previous literature one can conclude that there is no agreement with single definition for the pacemaker dependency. In general, pacemaker dependency is defined as inadequate or even absent intrinsic rhythm and therefore patient can suffer significant symptoms or cardiac arrest after cessation of pacing.[2,4]

In most of the reported papers, a decrease in the base paced rate 30–40 bpm is performed with close observation for an underlying intrinsic ventricular rhythm in addition to monitoring the patient symptoms. The assumption of symptoms and lowering the pacing rate to diagnose pacemaker dependency was conducted by many investigators.[6,7]

In the present study the definition of pacemaker dependency encompassed absence of intrinsic ventricular rhythm during backup pacing down to 30 bpm with careful assessment of patient symptoms related to bradycardia.

In the present study pacemaker dependency was identified in 17% of the enrolled patients, a wide range of incidence (2.1–50%) of pacemaker dependency was mentioned in the available literatures.[8,9] This difference may be attributable to the protocol that is used to define pacemaker dependency, Lelakowski et al.[10] used cessation of pacing for 5 second with inclusion of patient symptoms and the rate in his study was 2.1%, Nagatomo et al.[7] lowered the pacing rate to 30 bpm but didn't include the symptoms in the test for dependency, the rate of PMD in his study was 7.2%.

Glikson et al.[11] used 50 bpm as a cutoff point to define PMD, so the incidence of PMD was 50%.

Tang et al.[12] in his review to the of Canadian Trial Of Physiological Pacing (CTOPP) found that 45% of the studied patients have native rhythm more than 60 bpm, while 22% of the patients have a native rhythm below 40 bpm.

In accordance with other investigators,[7,8,10] patients with AVB in the present study have a higher rate of dependency, which can be due to lack of transmission of normal impulse from atria to ventricle so they are the most dependent group on ventricular escape rhythm.

We found that pacemaker dependency tends to be more common with increased percentage of pacing (which reflects total time of pacing) this was in consistence with the result of Nagatomo et al.,[7] this could be attributed to overdrive suppression or the patients already need for pacing.

The correlation between age or gender and pacemaker dependency was not statistically significant, this was in agreement with the result of Lelakowski et al. and Nagatoma et al.[7,10]

The different modes of pacing VVI, VDD, and DDD didn't affect the rate of dependency, this was concordant with the results by Lelakowski et al.[10] and Tang et al.[12]

There was no significant difference between the time that had elapsed since pacemaker implantation and prevalence of pacemaker dependency, this agrees with the result of Tang et al.[12]

Whether the pacemaker was programmed to rate adaptive mode or not, we found that it has not affected the incidence of dependency, here there was no data to compare with this finding.

It is important to mention that the data from this paper was based on single patient visit; many studies also used single snapshot evaluation of dependency.[7,11] In addition in the review of CTOPP trial by Tang et al. [12] he found that 21 % of patients were pacemaker dependent in the first visit and after 4 years of follow up 22% were dependent, that means there was no significant difference in the rate of dependency during long follow-up period.

Glikson et al.[11] involved some patients in his study to ambulatory monitoring to follow up the change in dependency; he found that the overall results correlation between a single visit and an ambulatory test was 92.9%.

Conclusion

Pacemaker dependency is frequent phenomenon among patients with permanent pacemaker. The prevalence of pacemaker dependency in our patients was 17%. The presence of complete heart lock and second degree block are the most underling rhythms associated with pacemaker dependency. Total time of pacing is significantly associated with dependency. Patient's demographic characteristics were not associated with pacemaker dependency. Mode of pacing, rate adaptive mode and time since pacemaker implantation were not found to be associated with pacemaker dependency. A reasonable decrease in total time of pacing may help decrease chance of pacemaker dependency.

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