International Journal of Cardiology 179 (2015) 214–216

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Letter to the Editor

The risk factors of the permanent pacemaker implantation in patients with postoperative delirium

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ARTICLE INFO

Article history:
Received 11 October 2014
Accepted 5 November 2014
Available online 6 November 2014

Keywords:
Permanent pacemaker implantation
Postoperative
Delirium

Postoperative mental dysfunction refers to abnormal postoperative patients with altered mental activity including understanding, emotions, behavior and even with various degrees of movement disorders [1,2]. Previous study established that the complexity of the surgery increases the incidence of trauma which eventually increases the incidence of postoperative delirium (POD) [3]. Thus POD is referred as one of the manifestations of postoperative mental disorders. Meta-analysis by Wong et.al provided evidence that shows that delirium in elderly patients is associated with poor outcome which is independent of important confounders such as age, sex, baseline dementia, comorbid illness and illness severity [4]. Some studies have mentioned that the pacemaker implanted patients have an early postoperative concurrent mental status change which was initially thought to be transient ischemic attack (TIA) [5]. However, there is limited data regarding the predictive value of postoperative delirium for long-term poor outcome in Chinese patients with permanent pacemaker implantation. Therefore, we aimed to assess the risk factors of the permanent pacemaker implantation in Chinese patients with postoperative delirium.

A total of 773 consecutive patients (age 71.4 ± 8.6 years, 405 men) who need to implant permanent pacemaker were admitted in our department from April 2008 to April 2014. The patients with severe liver dysfunction, severe renal dysfunction, severe respiratory disease (AECOPD, asthma, lung infection etc.) or taking antipsychotic drugs in the past or currently were excluded from our study. All baseline clinical characteristics including postoperative pain, postoperative heart rhythm categories (pacing rhythm and autonomous cardiac rhythm), pacemaker types (single-chamber, dual-chamber and three-chamber pacemaker), admission ward (cardiac care unit and general ward) and records of prescribe antibiotics were carefully recorded. The Confusion Assessment Method (CAM) was used for identification of delirium through assessments of the presence, severity and fluctuation of all nine delirium features. The nine delirium features include acute onset, inattention, disorganized thinking, altered level of consciousness, disorientation, memory impairment, perceptual disturbances, psychomotor agitation or retardation, and altered sleep–wake cycle. The sensitivity and specificity of CAM were 86% and 93% respectively [4]. We divided all the patients into the POD group and the non-POD group according to whether new onset delirium was diagnosed during hospitalization.

Baseline characteristics of our study population were shown in Table 1. There were altogether 64 (8.28%) patients who develop new-onset delirium during hospitalization, and the proportion of patients in cardiac care unit from the POD group were significantly higher than the non-POD group (18.75% vs. 7.90%, $P = 0.003$). Patients with POD tended to be older, and have a lower body weight than those from the non-POD group ($P < 0.001$). In the POD group of patients with coronary artery disease and NYHA class III and above, the use of quinolone antibiotics is higher than that of proportion of the non-POD group, however the difference was not statistically significant ($P > 0.05$). Psychiatric symptoms were outline as the dependent variable whereas age, weight, sex, history of coronary heart disease (CHD), hypertension, previous stroke, diabetes mellitus, cardiac function, renal function, current smoking, history of hypnotics use, postoperative pain, postoperative pacing rhythm, admission ward type (cardiac care unit and general ward), and type of antibiotic used were outline as independent variables. Initially univariate regression analysis of the independent variables was screened and found that age, weight, history of CHD, history of the use of sleeping pills, ward types and types of antibiotics used have small statistical meaning. However, forward stepwise logistic regression analysis of the above risk factors as independent variables, using forward method and correcting for confounding factors ultimately outlines old age (OR, 1.038, 95% CI: 1.00–1.077, $P = 0.048$), low birth weight (OR, 0.907, 95% CI: 0.879–0.935, $P < 0.001$), cardiac care unit (OR, 3.372,95% CI: 1.589–7.153, $P = 0.002$) as the independent risk factors in pacemaker patients with mental symptoms (Table 2).

Clinical features of psychotic symptoms in postoperative patients are as follows: (1) Delirium were more likely occur in the first postoperative night (93.75%), and most of them return to normal within 24 h (98.43%). (2) Patients usually present with excitement, hallucinations,

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http://dx.doi.org/10.1016/j.ijcard.2014.11.060
0167-5273/

Table 1
Baseline characteristics of permanent pacemaker implantation patients with or without POD during hospitalization.

	POD group (n = 64)	Non-POD group (n = 709)	P
Clinical characteristics			
Age (years)	74.4 ± 4.9	71.2 ± 8.8**	<**0.001**
Male (n, %)	30 (46.88)	375 (52.89)	0.356
Weight (kg)	57.2 ± 8.5	66.5 ± 10.8**	<**0.001**
CHD (n, %)	39 (60.9)	351 (49.5)	0.080
Hypertension (n, %)	44 (68.8)	448 (63.2)	0.376
Diabetes mellitus (n, %)	18 (28.1)	159 (22.4)	0.299
Previous stroke (n, %)	9 (14.1)	85 (12.0)	0.627
NYHA classification >2	10 (15.63)	55 (7.76)	0.086
Renal insufficiency (n, %)	4 (6.3)	45 (6.3)	1.000
Current Smoking (n, %)	17 (26.6)	203 (28.6)	0.725
History of taking hypnotics (n, %)	14 (21.9)	100 (14.1)	0.093
Postoperative pain (n, %)	15 (23.4)	126 (17.8)	0.261
Pacing rhythm at postoperative (n, %)	54 (84.4)	553 (78.0)	0.234
Cardiac care unit (n, %)	12 (18.75)	56 (7.90)**	**0.003**
Quinolone antibiotics (n, %)	13 (20.3)	85 (12.0)	0.055
Pacemaker types			0.608
Single-chamber (n, %)	23 (35.94)	223 (31.45)	
Dual-chamber (n, %)	39 (60.94)	449 (63.33)	
Three-chamber (n, %)	2 (3.13)	37 (5.23)	
Complications at postoperative (n, %)	4 (6.3)	23 (3.2)	0.369

POD = postoperative delirium; CHD = coronary heart disease.
* P < 0.05.
** P < 0.01.

delusions, agitation, abnormal behavior, refusal to treatment, removal of infusion tube, monitoring the line and a variety of pipes regardless advices from doctors, unable to identify places and responding with irrelevant answers. (3) Movement disorder during hospitalization, slurred speech and pathological reflex was negative. (4) The Cranial Computed Tomography (CT) shows the absence of bleeding or infarction. (5) Sedative medication was avoided. (6) After the return to normal consciousness they didn't have any serious neurologic sequelae.

The susceptible and predisposing factors for psychotic symptoms are similar but it is difficult to completely separate from each other [3,6]. The common susceptible factors include; dementia, low level of education, elderly, serious complications, visual injury, depression, alcohol abuse, malnutrition and history of taking sedative drug. Predisposing factors include; serious medical conditions, infections, dehydration, electrolyte imbalance, severe liver disease, alcohol or benzodiazepine class of drugs, epilepsy, central nervous system injury, acute myocardial infarction, heart failure, elective or emergency surgery, intraoperative anesthesia, postoperative pain, and other mental symptoms accompanied by a lack of family care. Pathological mechanism shows that it may be related to IL, GSF, IFN, serum cortisol, CRP etc. [7–10]. Some authors [11] considered that the lack of cholinergic substance or hypofunction of cholinergic neurons is the last “channel” for the occurrence of psychiatric symptoms.

Table 2
Multivariate logistic regression analysis for the potential risk factors of POD in the patients with pacemaker implanted.

	B	SE	Wald	P	OR	95% CI
Age	0.037	0.019	3.908	**0.048***	1.038	1.000–1.077
Weight	−0.098	0.016	38.110	**0.000****	0.907	0.879–0.935
CHD	0.596	0.288	4.290	**0.038***	1.815	1.033–3.191
History of taking hypnotics	0.479	0.339	2.000	0.157	1.614	0.831–3.135
Cardiac care unit	1.215	0.384	10.033	**0.002****	3.372	1.589–7.153
Quinolone antibiotics	0.346	0.364	0.903	0.342	1.413	0.693–2.882

POD = postoperative delirium; CHD = coronary heart disease.
* P < 0.05.
** P < 0.01.

Postoperative psychiatric symptoms may lead to prolonged hospitalization, physical function decline, increased risk of postoperative complications and even increased mortality [12–15]. Postoperative psychiatric symptoms combined with the characteristics of pacemaker implantation increases risk of postoperative electrode dislocation, cardiac perforation, wound tear, cut bleeding, pocket infection and slow healing.

In this study, the age difference was statistically significant in both of the groups. Logistic regression analysis showed that elderly patients were prone to psychiatric symptoms which are consistent with previous studies [3,16,17]. This could be explained by following points: (1) Nerve cells decline with aging, thus reduction in the acceptance of the number and quality of information from outside environment. (2) Degeneration of brain tissue itself which is central to neurotransmitters such as acetylcholine, norepinephrine, and epinephrine and change in its content. (3) The nucleus caducity of limbic system and locus coeruleus may reduce the brain function. (4) Reduction in cerebral blood flow and glucose metabolism increases sensitivity to hypoxia, and reduction of drug metabolism in elderly may increase the risk of occurrence of postoperative mental disorders.

John A et al. [18] found that 25% patients in the CCU will encounter mental problems. The study demonstrated that the admission ward type is also an independent risk factor for postoperative psychiatric symptoms. In CCU, the patients are mostly of acute myocardial infarction, severe bradyarrhythmia, tachyarrhythmia and other critical disease. The patient's own serious illness may lead to increase in blood cortisol and CRP concentrations that result in further stress which eventually increase the risk of psychiatric symptoms in these patients.

Risk factors outline in this study have some difference compared to that of previous studies. (1) History of taking hypnotics (P = 0.093); patients enrolled in our study don't have long-term history of drug use. Most patients take hypnotics for short periods and in low dose. Previous study demonstrated that the occurrence of psychotic symptoms with patients taking sedative drugs has a positive correlation with the doses of drugs [19]. (2) Pacemaker implant surgery using local anesthesia and use lower dose of narcotic; Sieber FE et.al reports that, the lower degree of intraoperative anesthesia has a smaller probability of the occurrence of postoperative psychotic symptoms [20]. Pacemaker implantation is minimally invasive surgery, and the pain is easy to control. Compared to patients with higher body weight to that of lower body weight, they may have more intense foreign body sensation after implantation of a pacemaker. Moreover, patients with implanted pacemaker surgery require restricting activity.

In summary, elderly patients, low weight, CHD, and admission ward types were independent risk factors of postoperative delirium. Although the incidence of postoperative complications has no-significant difference (P = 0.369) in the POD group and the non-POD group, the harm of POD should not be underestimated. In other hand, there is no specific follow-up study for such patients. Therefore, multi-center, large-scale clinical study should be carried out for further understanding.

Conflicts of interest

None.

Financial disclosures

None declared.

Acknowledgment

The authors of this manuscript have certified that they comply with the Principles of Ethical Publishing in the International Journal of Cardiology.

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