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Safety of Transvenous Temporary Cardiac Pacing in Patients with Accidental Digoxin Overdose and Symptomatic Bradycardia

Ju-Yi Chen[a] Ping-Yen Liu[a,b] Jyh-Hong Chen[a] Li-Jen Lin[a]

[a]Division of Cardiology, Department of Internal Medicine, National Cheng Kung University Hospital and [b]Institute of Clinical Medicine, National Cheng Kung University, Tainan, Taiwan

Key Words
Digoxin overdose · Bradyarrhythmias · Pacemaker

Abstract
Background: Patients with digoxin intoxication may need transvenous temporary cardiac pacing (TCP) when symptomatic bradyarrhythmias are present. However, it has been reported that TCP might be associated with fatal arrhythmias in patients with acute digitalis intoxication caused by attempted suicide. The aim of this study was to assess the safety of TCP in patients with accidental digoxin-related symptomatic bradyarrhythmias. ***Materials and Methods:*** Seventy patients (30 men; age 74 ± 12 years) were enrolled in this retrospective study. Patients were divided into two groups: group 1 with TCP and group 2 without TCP. A digoxin overdose was defined as a serum digoxin level higher than 2.0 ng/ml combined with the presence of digoxin-related symptoms. Detailed clinical characteristics were reviewed on the basis of the medical records. ***Results:*** Group 1 included 24 patients (34.3%, 10 men). The rhythms prior to pacemaker insertion in group 1 included sinus arrest with junctional bradyarrhythmias (n = 9), atrial fibrillation with a slow ventricular rate (n = 11), and high-degree atrioventricular block (n = 4). The mean duration of pacemaker implantation was 5.8 ± 2.9 days (2–12 days). There was no major arrhythmic event or mortality after TCP in group 1. Two patients in group 2 (4%) died of ventricular tachyarrhythmias. Group 1 had a higher level of blood urea nitrogen (45.1 ± 26.0 vs. 33.4 ± 19.3 mg/dl), of left ventricular ejection fraction (68 vs. 56%), and of digoxin (4.4 ± 2.1 vs. 3.4 ± 1.3 ng/ml) but a lower serum calcium level (8.7 ± 0.6 vs. 9.1 ± 0.8 mg/dl). ***Conclusion:*** TCP was safe for patients with a digoxin overdose complicated by symptomatic bradycardia and should be recommended in such situations. However, this conclusion does not apply to acute digoxin intoxication as a result of attempted suicide.

Introduction

Patients with digoxin intoxication may need transvenous temporary cardiac pacing (TCP) when symptomatic bradyarrhythmias are present. However, it had been reported that this procedure might be complicated by fatal arrhythmias and resulted in a less favorable outcome in patients with acute digitalis intoxication caused by attempted suicide [1, 2]. Though this complication had not been reported in similar patients with accidental digoxin

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Li-Jen Lin, MD
Division of Cardiology, Department of Internal Medicine
National Cheng Kung University Hospital
138 Sheng-Li Road, Tainan 704 (Taiwan)
Tel. +886 6 235 3535, ext. 2382, Fax +886 6 275 3834, E-Mail linl@mail.ncku.edu.tw

Table 1. Cardiac rhythms in patients with (group 1) and without (group 2) TCP

Rhythm	Group 1 (n = 24)	Group 2 (n = 46)
Normal sinus rhythm	0 (0)	13 (28.3)
Atrial fibrillation with ventricular rate >60/min	0 (0)	28 (60.9)
Atrial fibrillation with ventricular rate <50/min	11 (45.8)	0 (0)
High-degree atrioventricular block	4 (16.7)	0 (0)
Sinus arrest with junctional escape rhythm	9 (37.5)	3 (6.5)
Permanent pacemaker rhythm	0 (0)	2 (4.4)

Figures in parentheses represent percentage.

overdose, it might possibly restrict the recommendation of this procedure in such patients. Moreover, the safety of TCP in the latter condition had never been evaluated before. In order to elucidate this issue, we conducted a retrospective study to assess the safety of TCP in patients with symptomatic bradyarrhythmias resulting from an accidental digoxin overdose.

Methods and Materials

Subjects

Between 1988 and 2002, 70 patients (30 men and 40 women, aged 74 ± 12 years) with a diagnosis of digoxin intoxication at the National Cheng Kung University Hospital were included in this retrospective study. A digoxin overdose was defined as a serum digoxin level of more than 2.0 ng/ml together with digoxin-overdose-related symptoms, including nausea, vomiting, anorexia, weakness, syncope, dizziness and a change in consciousness. Clinical characteristics, including underlying diseases, the serum digoxin level, symptoms of digoxin overdose, the cardiac rhythm before TCP, the final outcome and complications related to TCP, such as infection, venous thrombosis and cardiac rupture, were carefully reviewed on the basis of the medical records. Patients were divided into two groups: group 1 with TCP and group 2 without TCP.

Temporary Cardiac Pacing

TCP was performed by either experienced cardiologists or cardiology fellows with supervision by experienced attending cardiologists. An exclusively internal jugular approach was used for venous access. This procedure was undertaken using either a 6-french non-balloon-tipped bipolar electrode catheter with the assistance of fluoroscopy or a 5-french balloon-tipped electrode catheter without fluoroscopy.

Statistical Analysis

Clinical characteristics of patients were compared between these two groups. Statistical analyses were conducted with a software program (SPSS 8.0 for Windows; SPSS, Chicago, Ill., USA). The χ^2 test was used to evaluate the differences in categorical variables. Differences of continuous variables were evaluated with Student's t test. All data were presented as mean ± standard deviation. A p value of less than 0.05 was considered statistically significant.

Results

Patient Characteristics

Group 1 included 24 patients (34.3%, 10 men) who underwent TCP for symptomatic bradyarrhythmias. Group 2 included 46 patients (65.7%, 20 men). Cardiac rhythms prior to pacemaker insertion are listed in table 1. No patient in group 1 had a normal sinus rhythm or any rhythm with a heart rate higher than 60/min, which included atrial fibrillation with slow ventricular rate, high-degree atrioventricular block, and sinus arrest. Thirteen patients in group 2 had sinus rhythm. Moreover, permanent pacemaker rhythm appeared in 2 patients in group 2. Other clinical characteristics are listed in table 2. Between these two groups, there was no difference with respect to age, gender, daily dose of digoxin, and underlying diseases. The incidences of presenting symptoms were also quite similar except syncope, which was more common in group 1 (29 vs. 4%, $p < 0.05$). Group 1 had a higher blood urea nitrogen level (but not creatinine), a lower serum calcium concentration (8.7 ± 0.6 vs. 9.1 ± 0.8 mEq/l, $p < 0.05$), and a higher serum digoxin concentration (4.4 ± 2.1 vs. 3.4 ± 1.3 ng/ml, $p < 0.05$). Moreover, the left ventricular ejection fraction was normal in both groups but higher in group 1.

Clinical Outcomes

For patients in group 1, the mean duration of TCP was 5.8 ± 2.9 days (2–12). There were neither additional arrhythmic events nor other complications related to TCP, such as infection, venous thrombosis and cardiac rupture, in group 1. There was no mortality in group 1. However, 2 patients (4%) in group 2 died of ventricular tachyarrhythmias. Their initial rhythms before TCP were atrial fibrillation with moderate ventricular response and sinus arrest with a junctional escape rhythm of 50 beats/min, respectively. The parameters between patients with or

Table 2. Clinical characteristics of patients with (group 1) and without (group 2) TCP

	Group 1 (n = 24; 34.3%)	Group 2 (n = 46; 65.7%)
Age, years	75 ± 12	73 ± 12
Gender (M/F)	10/14	20/26
Body weight, kg	53 ± 12	51 ± 11.3
Daily digoxin dose, mg	0.21 ± 0.06	0.25 ± 0.22
Associated diseases		
Chronic renal failure	7/24 (29.2)	9/46 (19.6)
Congestive heart failure	6/24 (25.0)	18/46 (39.1)
Diabetes mellitus	2/24 (8.3)	11/46 (23.9)
Hypertension	9/24 (37.5)	17/46 (37.0)
Stroke	4/24 (16.7)	6/46 (13.0)
Symptoms		
Nausea	7/24 (29.2)	21/46 (45.7)
Vomiting	7/24 (29.2)	21/46 (45.7)
Poor appetite	4/24 (16.7)	11/46 (23.9)
Weakness	10/24 (41.7)	13/46 (28.3)
Dizziness	6/24 (25.0)	11/46 (23.9)
Syncope	7/24 (29.2)	2/46 (4.4)*
Laboratory data		
Serum digoxin level, ng/ml	4.4 ± 2.1	3.4 ± 1.3*
Blood urea nitrogen, mg/dl	45.1 ± 26.0	33.4 ± 19.3*
Serum creatinine, mg/dl	2.7 ± 3.1	2.0 ± 1.8
Serum sodium, mEq/l	136 ± 5	135 ± 6
Serum potassium, mEq/l	4.7 ± 1.1	4.3 ± 1.0
Serum magnesium, mEq/l	2.1 ± 0.3	2.4 ± 0.5
Serum calcium, mg/dl	8.7 ± 0.6	9.1 ± 0.8*
Echocardiograms		
LVEF, %	68.6 ± 11.4	56.2 ± 17.8*
AO, cm	3.1 ± 0.5	3.3 ± 0.7
LA, cm	4.0 ± 0.9	4.3 ± 1.1

Values are presented as mean ± SD. Figures in parentheses represent percentage. LVEF = Left ventricular ejection fraction; AO = diameter of aortic root (end-diastolic phase); LA = diameter of left atrium (end-diastolic phase). * <0.05.

without ventricular tachyarrhythmias and mortality were both statistically insignificant. Moreover, TCP itself was not an independent risk factor for prognosis (p = 0.543).

Discussion

Major Study Findings

Studies regarding the effects of TCP in patients with acute digitalis intoxication showed adverse results [1, 2]. The safety of TCP has never been evaluated in patients with accidental digoxin overdose complicated by symptomatic bradycardia. This may lead to concern about the safety of TCP in such patients. Our study showed that, in such a clinical setting, TCP was safe and did not cause any iatrogenic complications. Some of the clinical characteristics in group 1 were less favorable, such as a higher serum digoxin concentration and blood urea nitrogen level. However, these unfavorable indices did not worsen the clinical outcome in patients with TCP. Therefore, TCP is safe in patients with accidental digoxin overdose complicated by symptomatic bradycardia.

Cardiac Pacing in Acute Digitalis Intoxication

In the literature, it had been reported that TCP might be associated with fatal arrhythmias in patients with acute intoxication caused by attempted suicide [1, 2]. In the prospective study of Bismuth et al. [1], 16 out of 17 patients with acute digitoxin intoxication that died had received TCP. A total of 68 patients underwent this procedure, 16 (23%) of whom died. Of these 16 mortalities, 5 died of ventricular fibrillation. The same research group later conducted a retrospective study to compare the therapeutic effects of Fab fragments (an antibody for digoxin) and TCP for acute digitoxin intoxication [2]. Similarly, TCP failed to prevent life-threatening arrhythmia. Furthermore, TCP was also frequently associated with iatrogenic accidents (36 vs. 0%) and might cause mortality (13 vs. 0%).

The hazardous complications of TCP in patients with acute digitoxin intoxication might be attributed to more severe digitalis intoxication, which has been reported to facilitate repetitive ventricular responses and to decrease the electric current required to bring delayed after-depolarization to threshold potential [3]. In the study of Taboulet et al. [2], TCP worked on the basis of overdriving the potential ventricular arrhythmia caused by digitalis intoxication. Though the pacing rate was not mentioned in this study, we speculated that it was possibly higher than what we used for backup pacing in the current study (around 60/min). With a higher pacing rate, TCP might lead to a higher incidence of pacing-related ventricular arrhythmia. In animal experiments, it was shown that as the driving rate increased, the after-depolarization caused by digitalis tended more readily to attain threshold and initiated a ventricular rhythm whose rate increased in proportion to the drive rate [3]. In brief, when acting as an overdriving modality, TCP might increase the risk of ventricular tachyarrhythmias, hence resulting in more hazardous complications.

Conclusion

TCP did not cause any major cardiac arrhythmia in patients with symptomatic bradyarrhythmias resulting from accidental digoxin overdose and should be recommended for this digoxin complication. However, this conclusion cannot be applied to acute digoxin intoxication as a result of attempted suicide.

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