

Study of High Risk Factors for Lower Extremity Venous Thrombosis after Temporary Cardiac Pacemaker *via* Femoral Vein

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Wang *et al.*: High Risk Factors for Lower Extremity Venous Thrombosis after Temporary Cardiac Pacemaker

This study is to identify the high-risk factors for the occurrence of lower extremity venous thrombosis after temporary cardiac pacemaker *via* femoral vein. 210 patients who underwent temporary cardiac pacing *via* the femoral vein at Chongqing University Three Gorges Hospital from January 2017 to August 2022 were selected for the study. The patients were divided into non-thrombosis group (n=198) and thrombosis group (n=12) according to their lower extremity venous thrombosis. Baseline characteristics of the two groups were compared, and binary logistic regression was used to analyze the risk factors for developing lower extremity venous thrombosis after surgery. The proportion of combined diabetes and acute cerebral infarction was higher in the thrombosis group than in the non-thrombosis group, and the indwelling time of temporary pacing electrodes was longer in the thrombosis group than in the non-thrombosis group ($p<0.05$). Logistic regression presented that combined diabetes, acute cerebral infarction, and long placement time of temporary pacing electrodes were high risk factors for the development of lower extremity venous thrombosis after surgery ($p<0.05$). The placement duration (d) of temporary pacing electrodes had predictive value for the occurrence of lower extremity venous thrombosis after surgery, with the best predictive value of 3.5 d, sensitivity of 66.7 % and specificity of 80.8 % ($p<0.05$). Diabetes, acute cerebral infarction and prolonged placement of temporary pacing electrodes are high-risk factors for lower extremity venous thrombosis after temporary cardiac pacing through the femoral vein, and the indwelling time of the temporary pacing electrode (d) more than 3.5 d had a predictive significance for postoperative venous thrombosis of the lower extremity.

Key words: Temporary pacemaker, femoral vein therapy, venous thrombosis

Temporary cardiac pacing is performed by implanting temporary electrodes in the right ventricle *via* intravenous route^[1,2]. Temporary pacemakers are widely adapted clinically, not only for emergency pacing in diseases such as significant bradycardia, cardiac arrest or third-degree atrioventricular block, but also for perioperative protection in surgical procedures in patients with pathological sinus node syndrome, among others^[2,3]. The femoral vein route is the fastest and most efficient way to perform emergency pacing electrode insertion, and it does increase the risk of venous thrombosis and pulmonary embolism compared to other sites^[4]. Therefore, it is clinically important to identify the risk factors for venous thrombosis after temporary pacemaker through the femoral vein. Inclusion criteria include patients older than 15 y old with temporary

pacemakers through the femoral vein at Chongqing University Three Gorges Hospital, between January 2017 and August 2022, were diagnosed and complete information on the duration of hospitalization is available. Exclusion criteria include patients who have been diagnosed with venous thrombosis before surgery; failure of temporary pacemaker placement and patients who did not cooperate with treatment and were not discharged as scheduled. After regular sterilization, the femoral vein was punctured by the Seldinger method and a 6F sheath (Cordis 11 cm) was placed. A St. Jude bipolar temporary pacing floating electrode is then delivered *via* sheath tube in the right ventricular apical region and connected to a temporary pacemaker (Medtronic). The decision to leave the sheath in place and the timing of indwelling is based on the condition. Directly by venous color

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Doppler, venous thrombosis of the lower extremities is found. Or based on the presence of extremity edema, cyanosis and pain, we suspect venous thrombosis, and also require venous color Doppler to confirm the diagnosis, and pulmonary embolism is confirmed by pulmonary computed tomography angiography. A total of 210 patients met the inclusion criteria between January 2017 and August 2022. Twelve of these patients developed lower extremity venous thrombosis, with a thrombotic incidence of 5.7 %. The gender, age, previous presence of hypertension and type 2 diabetes, Body Mass Index (BMI), etiology of temporary cardiac pacing, combined with acute cerebral infarction, malignancy, acute myocardial infarction, prophylactic anticoagulation with enoxaparin sodium, antiplatelet drugs, indwelling sheaths, and duration of temporary pacing electrode indwelling were collected from these 210 patients. The presence of swelling, redness, pain and other manifestations of venous thrombosis in the extremity to determine the lower extremity venous thrombosis, then further improve the lower extremity venous ultrasound to confirm the diagnosis, including intermuscular venous thrombosis and deep venous thrombosis. All statistical analyses were performed using Statistical Package for Social Sciences 25.0 statistical software. Means±standard deviations were used for measures obeying normal distribution, and medians (lower quartile~upper quartile) were used for measures not obeying normal distribution. The t-test or nonparametric test (Mann-Whitney U test) was used for comparison between groups for measurement data and the chi-square test was used for comparison between groups for count data. A multi-factorial logistic regression analysis was used to study the risk factors for venous thrombosis after temporary pacemaker through the femoral vein. $p < 0.05$ was considered a statistically significant difference. The proportion of combined diabetes and acute cerebral infarction was higher in the thrombus group than in the non-thrombus group and the indwelling time of temporary pacing electrodes was longer in the thrombus group than in the non-thrombus group ($p < 0.05$). The remaining clinical indicators were not statistically different (Table 1). Diabetes, acute phase cerebral infarction, indwelling sheath, and indwelling time were included as suspected influencing factors. Binary Logistic regression analysis was used. The conclusion suggested that combined diabetes, acute phase cerebral infarction, and postoperative indwelling of

the puncture sheath were high risk factors for venous thrombosis after temporary pacemaker surgery; the longer the indwelling time of temporary pacemaker electrodes, the higher the risk of thrombosis. Table 2 shows the details. The area under the curve of the receiver operating characteristic curve for the placement time of temporary pacemaker electrodes (d) was 0.762 (95 % Confidence Interval (CI) 0.615 to 0.908). The best predictive threshold for the development of postoperative venous thrombosis was 3.5 d, with a sensitivity of 66.7 % and specificity of 80.8 %; $p < 0.05$ (fig. 1). Temporary cardiac pacing *via* the femoral vein route is a quick, safe and effective method for cardiac emergencies, but the occurrence of venous thrombosis during pacing electrode placement remains a concern^[5]. Venous thrombosis and subsequent pulmonary embolism are serious complications of temporary cardiac pacing using the femoral vein route^[4]. The femoral vein route increases the risk of thrombosis compared to the internal jugular, subclavian and median elbow vein routes^[3]. In this study, we reviewed previous cases and analyzed the risk factors for venous thrombosis in temporary cardiac pacing *via* the femoral vein route. There are some guidelines for clinical prevention of venous thrombosis. Previous studies have confirmed that the incidence of asymptomatic lower extremity deep vein thrombosis associated with temporary cardiac pacing *via* the femoral route is approximately 25 % to 34 %, and venous thrombosis is directly associated with femoral pacemakers^[6-8]. Puncturing the femoral vein and leaving the sheath in place can damage the intima, which can activate platelets to release a variety of bioactive substances and initiate the endogenous coagulation system. This can cause platelet aggregation and adhesion, resulting in thrombosis. In addition, temporary cardiac pacing electrodes are passive electrodes, which are prone to electrode dislocation and require postoperative extremity bracing and bed rest to avoid the occurrence of electrode dislocation^[9]. The need for postoperative bed rest is an important factor in the occurrence of deep vein thrombosis and is associated with reduced venous blood return, inflammation and hypercoagulable state^[10]. The present study suggested that prophylactic use of enoxaparin was not effective in reducing the risk of postoperative lower extremity venous thrombosis. Nolewajka *et al.*^[4] found that venous thrombosis and subsequent pulmonary embolism were serious complications of temporary

cardiac pacing *via* the femoral route despite the use of prophylactic low-dose heparin. This study suggested that the proportion of diabetes mellitus was higher in the thrombotic group than in the non-thrombotic group. The findings of the multifactorial study suggested that diabetes was a high risk factor for venous thrombosis after temporary cardiac pacing *via* the femoral vein route (Odds Ratio (OR)=5.749, 95 % CI 1.438 to 22.979), with $p < 0.05$. A cohort study by Chung *et al.*^[11] showed a 1.44-fold increased risk of venous thrombosis in patients with type 2 diabetes compared to controls. Impaired fibrinolysis, platelet and endothelial cell dysfunction in diabetic patients predispose to a hypercoagulable state, which increases the risk of deep vein thrombosis and pulmonary embolism^[12,13]. This study suggested that acute cerebral infarction was a high risk factor for lower extremity venous thrombosis after temporary cardiac pacing *via* the femoral vein route (OR=10.47, 95 % CI 1.879-58.358), both in univariate and multifactorial analysis, with $p < 0.05$. Patients with acute cerebral infarction are often temporarily immobilized due to bed rest or neurological deficits in the affected extremity. As a result, thrombosis secondary to venous thrombosis is more likely to occur^[14,15]. The longer the duration (d) of temporary pacing electrode placement, the higher the occurrence of venous thrombosis after temporary cardiac pacing *via* the femoral vein route (OR=1.437, 95 % CI 1.143

to 1.805), with $p < 0.05$. If temporary cardiac pacing is required, it should be kept as short as possible, a strategy that avoids or reduces the potential complications associated with temporary pacemaker implantation, including venous thrombosis^[16]. Then, this study confirmed that temporary pacing electrodes left in place for more than 3.5 d (d) had diagnostic value for the occurrence of lower extremity venous thrombosis with a sensitivity of 66.7 % and specificity of 80.8 %, $p < 0.05$. It is recommended that, therefore, temporary pacing electrodes be left in place for no more than 3.5 d (d). If the condition does not allow the removal of temporary pacing electrodes, antithrombotic measures are recommended to prevent thrombosis. Diabetes, acute cerebral infarction, and prolonged placement of temporary pacing electrodes were high-risk factors for lower extremity venous thrombosis after temporary cardiac pacing accessible through the femoral vein route, and the placement duration (d) of temporary pacing electrodes > 3.5 (d) had predictive value for the occurrence of lower extremity venous thrombosis after surgery. To prevent lower extremity venous thrombosis, the focus should be on patients with diabetes and acute cerebral infarction in patients with temporary cardiac pacing *via* the femoral vein route. At the same time, temporary pacing electrodes should be removed as soon as the condition allows, avoiding indwelling for more than 3.5 (d).

TABLE 1: COMPARISON OF THE PROPORTION OF DIABETES AND ACUTE CEREBRAL INFARCTION IN THE THROMBOSIS GROUP AND NON-THROMBUS GROUP

Group		non-thrombus group (n=198)	thrombus group (n=12)	χ^2/Z	P
Etiology of temporary pacemaker implantation	Acute myocardial infarction [cases,%]	39 (19.7 %)	3 (25 %)	2.840 ^a	0.417
	Significant bradycardia or atrioventricular block [cases,%]	117 (59.1 %)	5 (41.7 %)		
	Intraoperative protection [cases,%]	38 (19.2 %)	3 (25 %)		
	Viral myocarditis [cases,%]	4 (2 %)	1 (8.3 %)		
Gender	Male [cases,%]	117 (59.1 %)	5 (41.7 %)	1.530 ^a	0.465
	Female [cases,%]	81 (40.9 %)	7 (58.3 %)		
Age (y) [#]		71 (61-77.5)	74 (64.5-84.75)	-1.075	0.282
BMI \geq 28 [cases,%]		14 (7.1 %)	1 (8.03 %)	0.027 ^a	0.869
Hypertension [cases,%]		55 (27.8 %)	5 (41.7 %)	1.069 ^a	0.301
Diabetes [cases,%]		25 (12.6 %)	5 (41.7 %)	7.793 ^a	0.005*
Combined malignancy [cases,%]		15 (7.6 %)	0 (0 %)	0.979 ^a	0.322
Combined acute phase cerebral infarction [cases,%]		5 (2.5 %)	3 (25 %)	15.596 ^a	<0.001*

Acute myocardial infarction [cases,%]	25 (12.6 %)	2 (16.7 %)	0.165 ^a	0.685
Prophylactic anticoagulation with enoxaparin [cases,%]	52 (26.3 %)	1 (8.3 %)	1.928 ^a	0.165
Use of antiplatelet agents [cases,%]	32(16.2 %)	2(16.7 %)	0.002 ^a	0.963
Indwelling sheaths [cases,%]	19(9.6 %)	2(16.7 %)	0.629 ^a	0.428
Duration of temporary pacing electrode placement [d] [#]	2 (1-3)	5 (2.25-6)	3.138	0.002*

Note: BMI: Body Mass Index; [#]: a non-normal distribution obtained by Shapiro-Wilk normality test; *: indicates $p < 0.05$

TABLE 2: INFLUENCING FACTORS OF DIABETES, ACUTE PHASE CEREBRAL INFARCTION, INDWELLING SHEATH AND INDWELLING TIME

		B	Standard Error	Wald	Degrees of freedom	Significance	OR	95% CI for OR	
								Lower limit	Upper limit
Diabetes	Yes	1.75	0.707	6.121	1	0.013	5.75	1.438	22.979
	No	0					1		
Combined acute phase cerebral infarction	Yes	2.35	0.877	7.178	1	0.007	10.5	1.879	58.358
	No	0					1		
Duration of indwelling of temporary pacing electrodes (d)		0.36	0.117	9.662	1	0.002	1.44	1.143	1.805
Constant		-4.8	0.721	43.61	1	0	0.01		

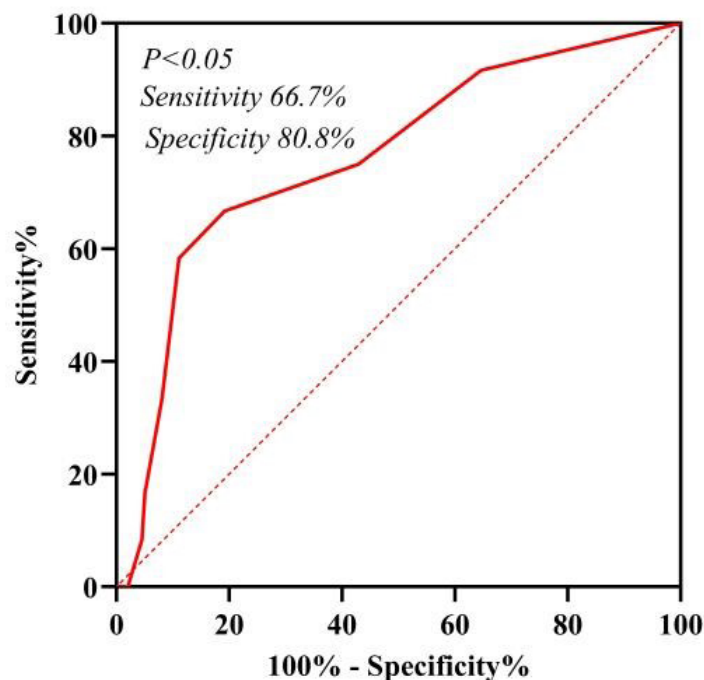


Fig. 1: Duration of temporary pacemaker placement (d)

Data sharing agreement:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of interests:

The authors declared no potential conflicts of interest with respect to the research, author-ship, and/or publication of this article.

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