



Efficacy of radiofrequency catheter ablation for premature ventricular contractions in children

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Abstract

Purpose This study evaluated the efficacy and safety of transcatheter radiofrequency ablation (RFCA) in treating ventricular premature contractions (PVCs) in children, summarized the countermeasures during intraoperative ventricular fibrillation (VF), and improved the safety of ventricular premature treatment.

Methods A retrospective analysis was conducted on 75 children with PVCs who received RFCA in the Second Affiliated Hospital of Wenzhou Medical University from January 2010 to April 2019. Data including age, sex, body weight, ejection fraction, left ventricular end diastolic diameter, burden and number of PVCs/24 h, origin of PVCs, and its complications were collected. Paired *t* test was used to compare changes in cardiac function before and after surgery.

Results Among the 75 cases treated with RFCA, 68 were successfully ablated, giving a success rate of 90.67%. After ablation, the left ventricular ejection fraction (LVEF) of the children was $69.13 \pm 3.81\%$, which was significantly higher than that before surgery ($69.13 \pm 3.81\%$ vs. $66.21 \pm 3.22\%$, $P = 0.012$). One of the patients experienced VF during the operation, with no other complications. The initial locus of origin was the anterior septum of the right ventricular outflow tract, but VF occurred during the ablation process. Mean follow-up time was 39 ± 33 months, with two recurrent cases (2.94%).

Conclusions Performing RFCA in children is safe and effective, with a low recurrence rate and few complications. VF is not an indication to cease surgery; the key to eliminating complications is repositioning the catheter and finding a more accurate origin point.

Keywords Premature ventricular contractions · Ventricular fibrillation · Radiofrequency catheter ablation · Children

1 Introduction

Premature ventricular contraction (PVC) is a common cardiac arrhythmia in children, and 24-h Holter monitoring has detected PVCs in up to 40% of healthy children [1]. The clinical manifestations of PVCs are complex and diverse, such as dizziness, palpitations, chest tightness, chest pain, and other discomforts. They can exist for a long period of time and attack intermittently. Particularly, frequent PVCs may potentially induce malignant arrhythmias, such as ventricular tachycardia (VT) [2]. Long-term high-load PVCs can lead to increased left ventricular end diastolic diameter (LVDd),

decreased left ventricular ejection fraction (LVEF), cardiac insufficiency, and arrhythmia-induced cardiomyopathy [3, 4]; these bring great harm to the patient's health. At present, beta-receptor blockers and other drugs are mainly used to treat frequent PVCs that cause obvious symptoms [5]. However, medications are sometimes ineffective or difficult to tolerate due to their adverse reactions, or children have poor oral drug adherence, bringing about the difficulty in treating PVCs. The long-term existence of PVCs limits the sports activities of children [6], and drug use affects the sleep cycle of children, which increases the psychological burden on the children and their families.

Several studies have shown that radiofrequency catheter ablation (RFCA) has a high success rate and curative effect in the treatment of most tachyarrhythmias, which greatly improved the quality of life of patients [7]. However, its efficacy and safety in the treatment of ventricular arrhythmia in children are still unknown [8, 9]. It has been reported that the success rate of catheter ablation for PVCs is between 60 and

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90%, and the total incidence of complications ranges from 3.1 to 5.2% [7, 10]. The complications are mainly related to manipulation methods, ablation technique, and the access sites [11]. Ventricular fibrillation (VF) is a rare complication that may be associated with inappropriate ablation, such as increased local myocardial sensitivity and mechanical stimulation of the catheter. Thus, we conducted this retrospective study to evaluate the efficacy and safety of PVC ablation in children. Since ablation treatment of PVCs can be complicated with VF during operation, countermeasures were done to improve the safety of treatment.

2 Methods

2.1 Study population

A retrospective analysis was conducted on 75 children with PVCs who underwent radiofrequency catheter ablation treatment in the Second Affiliated Hospital of Wenzhou Medical University from January 2010 to April 2019 (mean age 13.35 ± 3.15 years). The guidelines for radiofrequency ablation of ventricular arrhythmias in children were used as reference [12]. Inclusion criteria were as follows: (1) frequent or continuous PVCs, the average PVC count $\geq 10,000/24$ h; (2) weight ≥ 15 kg; (3) inability to tolerate PVCs or failure to treat with at least two anti-arrhythmic drugs; (4) did not wish to take long-time anti-arrhythmic drugs for specific reasons. Exclusion criteria were as follows: (1) recent infectious disease; (2) duration of viral myocarditis < 6 months; (3) severe chest deformity; (4) serious heart, lung, liver, kidney, and coagulation dysfunction making them unfit to undergo surgery. Before RFCA, all children underwent routine biochemical, coagulation function, x-ray, echocardiography, electrocardiogram, and dynamic electrocardiogram, and anti-arrhythmic drugs were discontinued for at least five half-lives. Demographic and clinical data were collected, including age, sex, body weight, EF, LVDd, burden and number of PVCs/24 h, the origin of PVCs, and its complications.

2.2 Ethics approval and consent to participate

The Ethics Committee of the Second Affiliated Hospital of Wenzhou Medical University approved this study, which was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from the parents of all individual participants included in the study.

2.3 Electrophysiological examination and radiofrequency ablation

Mapping and ablation were performed under the guidance of conventional x-ray fluoroscopy and three-dimensional

mapping system EnSite NavX or Carto. After induction of local or general anesthesia, a 5–7F sheath was inserted into the right femoral vein or femoral artery. Surface electrocardiogram (ECG) preliminarily determined the origin of the PVCs. A single four-grade ablation catheter was inserted directly through the sheath tube to the predicted site for electrophysiological examination, mapping, and ablation. A temperature-controlled or cold saline infusion ablation catheter, together with an excited order standard measurement complementary with the standard pacemaker test, was carried out with the PVC standard and ablation test. During pacing, the 12-lead electrocardiogram and QRS waves of spontaneous PVCs should at least be the same in at least 11 leads, or the early ablation target is considered as the QRS wave that was more than 25 ms ahead of the ventricular electrical PVCs; hence, continuous or intermittent discharges located the ablation catheter position. We set the ablation energy to 25–30 W, and controlled the temperature to 55 °C. The effective target was when the PVCs disappeared within 10 s of discharge, or the increased PVCs that appear were similar to spontaneous PVCs or short-burst VT that disappeared quickly. Consolidated discharges were continued for 60–180 s. After 30 min of ablation, the end point of ablation was determined with the disappearance of PVCs and when the original methods of inducing PVC, such as electrical stimulation and isoproterenol intravenous drip, were not effective. If the PVCs did not disappear after 10 s of discharge, the target was recalibrated. Discharges were stopped when it was noted that the catheter was displaced.

2.4 Follow-up methods

- (1) After ablation, routine ECG monitoring was performed for 48 h.
- (2) Each patient was documented and followed up to date.
- (3) All anti-arrhythmic drugs were discontinued.
- (4) Routine ECG and 24-h dynamic electrocardiogram (ECG) were re-examined 1 and 3 months after the operation to evaluate long-term efficacy.
- (5) Echocardiography was performed 3 months after the operation to evaluate cardiac function.
- (6) Patients were followed up by telephone 6, 12, and 18 months after surgery.
- (7) ECG and 24-h dynamic ECG were performed whenever patients had symptoms that indicated PVC recurrence.

2.5 Criteria for success in ablation

The criteria for immediate success were as follows [13]: (1) when the PVCs disappeared or there was only occasional PVCs (≤ 1 bpm) after ablation; (2) the total number of PVCs was less than 10 beats after 30 min of close observation (the

morphology was completely similar to that of preoperative PVCs). The criteria for long-term success were: (1) the disappearance of PVCs, (2) reduction of the total number of PVCs on the 24-h dynamic ECG during a period of 3 months post-operatively, with an obvious improvement of symptoms.

2.6 Statistical analysis

SPSS 18.0 was used for statistical analysis. The measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), while the counting data were expressed as the number of cases and percentage (%). Paired *t* test was used to compare the changes in cardiac function before and after RFCA. A *p* value of < 0.05 was considered statistically significant.

3 Results

3.1 Baseline characteristics

A total of 75 children was enrolled in this study, 40 males (53.33%) and 35 females (46.67%), with an average age of 13.35 ± 3.15 years (range 5–18 years) and an average weight of 48.50 ± 14.77 kg (range 19.5–91 kg). Thirty-six cases (48%) had obvious symptoms, such as palpitations, weakness, chest tightness, and dizziness (Fig. 1). All examined ECG tests showed no abnormalities, except for frequent PVCs and/or PVTs. For all patients with on/off treatment, the dynamic ECG recorded a PVC count of $27,738 \pm 12,497/24$ h (range 100,091–60,407/24 h), and the PVC load was $22.91 \pm 10.04\%$ (range 7–45.8%). Seventy-three patients had been

treated with two or more anti-arrhythmic drugs before ablation, which were ineffective or intolerable. Two patients had not used anti-arrhythmic drugs due to obvious symptoms. The average duration was 38.12 ± 31.75 months. Echocardiography showed an average LVEF of $66.21 \pm 3.22\%$ in all patients, with three cases having LVEF of $< 55\%$. The mean LVDd was 42.92 ± 5.99 mm. There were seven cases of left ventricular enlargement, three cases of mitral regurgitation, and seven cases of tricuspid regurgitation.

3.2 Electrophysiological study and ablation results

Among the 75 cases treated with RFCA, 68 cases (90.67%) were successfully ablated, while seven cases (9.3%) failed. Two of them had a significant reduction of PVCs after ablation, but they did not disappear. The form of PVCs remained the same as before. Two cases had polymorphous PVCs induced during surgery, which were traced by pacemaker mapping and excitation mapping. Multi-point ablation was performed, and premature ventricular flow still did not disappear. Two cases had origin right ventricular outflow tract revealed by routine electrocardiogram; however, no optimal origin was found in the right ventricular outflow tract or the left and right coronary sinus during the operation, and trial ablated ventricle did not disappear. One patient presented without PVCs after intraoperative anesthesia.

The origin of the PVCs was widely distributed in the vicinity of ventricular and vascular structures. Table 1 and Fig. 2 show the distribution of the origin of PVCs. Among the 68 cases of successful ablation of PVCs, 32 cases (47.06%)

Fig. 1 Distribution of symptoms. 39 of the 75 patients showed no symptoms of discomfort, while the other 36 showed varying degrees of PVC-related symptoms, such as chest tightness being the most common (23 cases), followed by palpitations (18 cases). One child developed syncope. PVCs, premature ventricular contractions

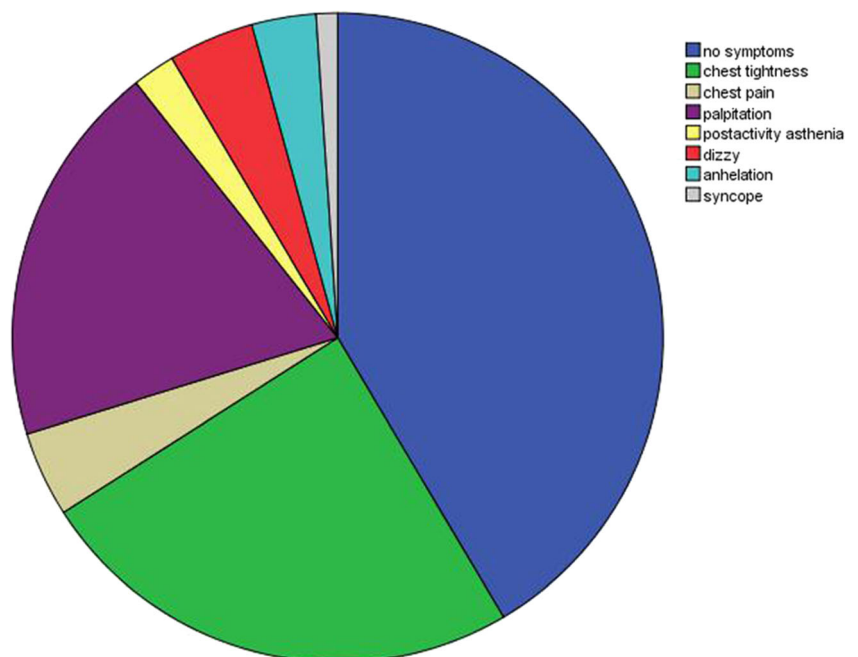


Table 1 Baseline characteristics of patients with PVCs of different origins

	RVOT	TA	Left coronary sinus	Right coronary sinus	Left ventricular septum	Other origin
Cases (%)	32 (47.06)	14 (20.59)	3 (4.41)	5 (7.35)	10 (14.71)	4 (5.88)
Sex (M/F)	18/16	8/6	0/3	2/3	9/1	3/1
Age (years)	13.63 ± 3.17	14.00 ± 3.39	14.33 ± 2.52	10.00 ± 3.81	12.70 ± 2.16	12.50 ± 4.51
Weight (kg)	50.92 ± 14.25	48.54 ± 16.52	44.33 ± 7.37	39.70 ± 14.64	48.30 ± 11.89	36.13 ± 11.79
Duration of illness (months)	34.06 ± 30.78	40.21 ± 37.41	42.00 ± 32.23	36.20 ± 14.18	46.70 ± 24.63	49.50 ± 47.59
Symptoms (%)	13 (40.63)	9 (64.29)	2 (66.67)	1 (25.00)	4 (40.00)	2 (50.00)
Number (/24 h)	30,368 ± 10,814	20,685 ± 5521	19,467 ± 13,054	39,456 ± 14,672	20,144 ± 12,657	37,471 ± 32,435
PVCs load (%)	24.80 ± 8.51	16.77 ± 5.08	16.85 ± 9.97	26.60 ± 14.59	18.64 ± 14.14	28.90 ± 23.90
LVEF (%)	67.13 ± 6.38	68.77 ± 4.15	66.00 ± 1.73	64.00 ± 4.83	67.33 ± 2.06	66.67 ± 2.89
LVDd (mm)	45.03 ± 5.49	41.77 ± 3.49	41.33 ± 10.06	39.75 ± 7.36	45.00 ± 4.60	36.67 ± 3.79

PVCs, premature ventricular contractions; RVOT, right ventricular outflow tract; TA, tricuspid annulus; LVEF, left ventricular ejection fraction; LVDd, left ventricular end diastolic diameter

originated from the right ventricular outflow tract (RVOT) (Fig. 3), 14 cases (20.59%) from the tricuspid annulus (TA) (Fig. 4), three cases (4.41%) from the left coronary sinus of aorta, five cases (7.35%) from the right coronary sinus, ten cases (14.71%) from the left ventricular septum, and the other four cases (5.88%) originated from the great cardiac veins (one case), the anterior left ventricular lateral wall (one case), and the papillary muscle (two cases). The starting point of the ventricular potential of the effective target site was 32.66 ± 5.03 ms earlier than the onset of the QRS wave of PVCs on the surface ECG in 68 patients with successful ablation (Table 1).

3.3 Complications

In the 74 children with PVCs who underwent RFCA, only one case had ventricular fibrillation, and no other complications occurred in the other cases. This was a 15-year-old male who

underwent excitation and pacing mapping under the guidance of Carto three-dimensional mapping system. The QRS wave pattern was similar to that of the 12-lead ECG on the RVOT and was recorded in the anterior septum of the RVOT. The starting point of the ventricular potential of the effective target site was 28 ms earlier than the onset of the QRS wave of the surface 12-lead ECG. With this site as the target, VF occurred after 10 s of discharge. Discharge was stopped immediately, and sinus rhythm was restored after defibrillation (200 J). A similar pattern was then recorded nearby, where the ventricular local potential was recorded 32 ms earlier than the surface ECG QRS wave. With this as the target, VF occurred again after 8 s of discharge; the discharge stopped. The rhythm was restored again after defibrillation. Therefore, the site was abandoned and transferred to the right pulmonary sinus valve, where similar QRS patterns were recorded. The ventricular local potential was recorded 42 ms earlier than the surface

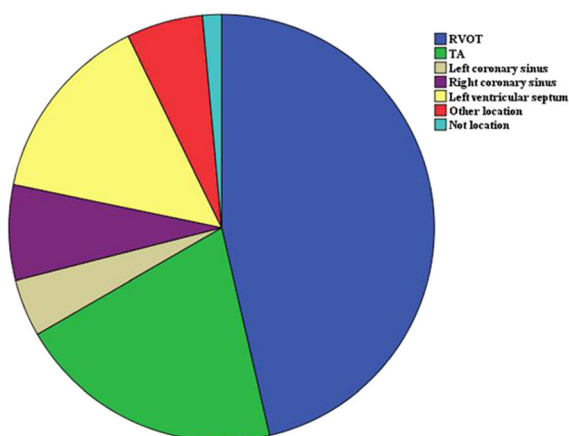
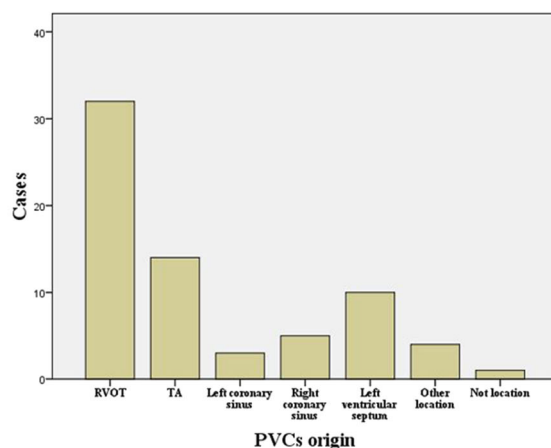


Fig. 2 Distribution of PVC origin. Of the 68 cases with successful ablation, the RVOT was the most common, accounting for 32 cases (47.06%), followed by 14 cases (20.59%) of PVCs originated from the TA, three cases (4.41%) originated from the left coronary sinus, five cases (7.35%) from the right coronary sinus, 10 cases (14.71%) from the left



ventricular septum, and the other 4 cases (5.88%) originated from the great cardiac veins (1 case), the anterior left ventricular lateral wall (1 case), and the papillary muscle (2 cases). PVCs, premature ventricular contractions; RVOT, right ventricular outflow tract; TA, tricuspid annulus

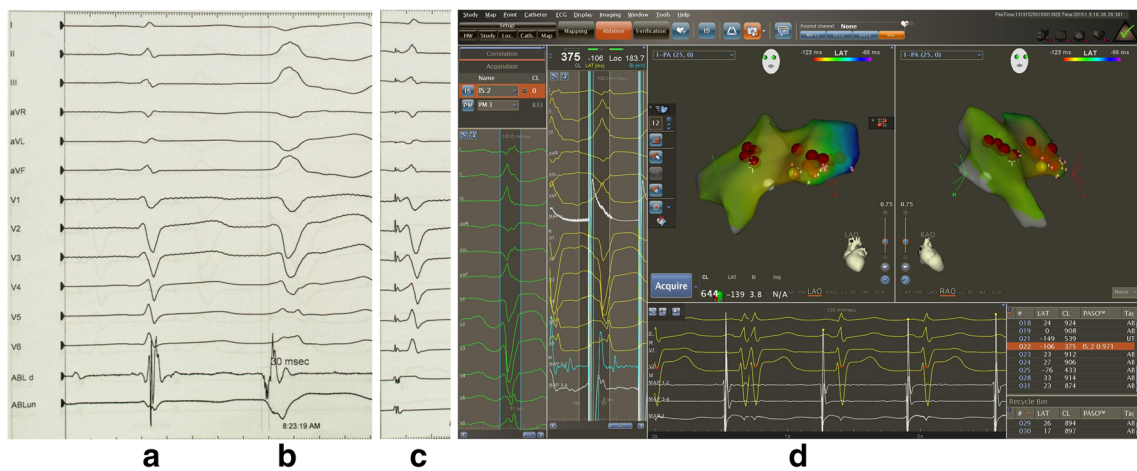


Fig. 3 PVC originated from the RVOT ablation and activation mapping using the Carto system. (A) Normal sinus rhythm. (B) The earliest ventricular potential time was 30 ms earlier than the onset of the QRS wave of PVCs on surface ECG. (C) The pacemaker 12-lead ECG QRS pattern was similar to that of spontaneous ventricular premature beat. (D) Carto

mapping system indicated that the target was located in the anterior and right sinus of the pulmonary artery (red). PVCs, premature ventricular contractions; RVOT, right ventricular outflow tract; ECG, electrocardiogram

ECG QRS, which was then taken as the target. After repeated discharges of 180 s × 3, the PVCs disappeared. Isoproterenol was administered as an intravenous drip; 15 min observation was done twice. No recurrence was found; hence, the operation was successful (Fig. 5).

3.4 Post-operation follow-up

Seventy-five children were followed up for 2 months to 8 years, with an average follow-up of 39 ± 33 months. Recurrence occurred in two cases (2.94%). Among the 68 cases with successful ablation, ECG monitoring observed PVCs < 1000/24 h again in 10 children 48 h after surgery, and the morphology was the same as that before surgery.

However, 1 month after the operation, the dynamic ECG was reviewed, and the PVCs disappeared. One case of PVC from TA recurred on the same night after the surgery. During the follow-up, there was no reduction. Re-operation was suggested, but the guardian of the child refused. Another case of PVC that originated from the papillary muscle of the posterior left ventricle group recurred 3 months after the surgery. One year later, another RFCA was successfully performed. The intraoperative standard point of origin was still the papillary muscle of the posterior left ventricle group. To date, the children with VF during the operation had no PVCs since the postoperative follow-up; their heart functions were normal. In seven patients who gave up or failed, PVCs gradually decreased during follow-up.

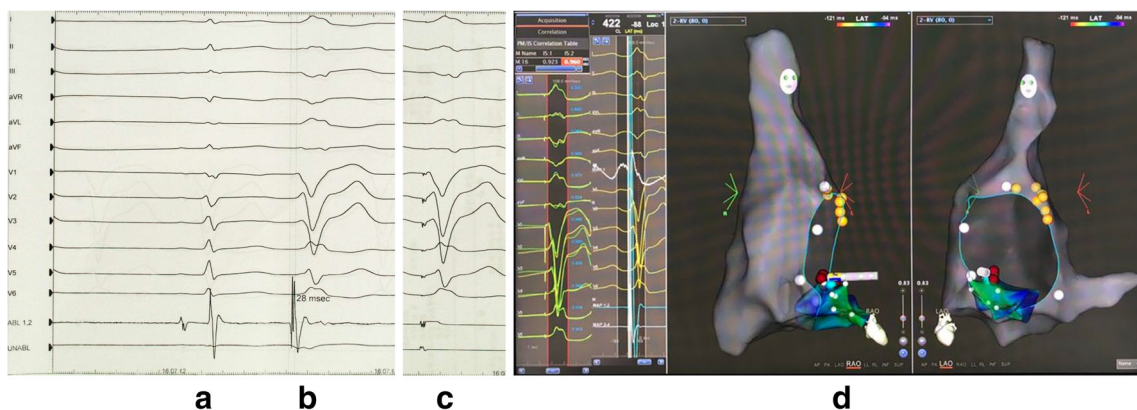


Fig. 4 PVC originated from the TA ablation and activation mapping using the Carto system. (A) Normal sinus rhythm. (B) The earliest ventricular potential time was 28 ms earlier than the onset of the QRS wave of PVCs on surface ECG. (C) The pacemaker 12-lead ECG QRS pattern

was similar to that of spontaneous ventricular premature beat. (D) Carto marking system indicates that the target is located 7 points in the tricuspid ring (red). PVCs, premature ventricular contractions; TA, tricuspid annulus; ECG, electrocardiogram

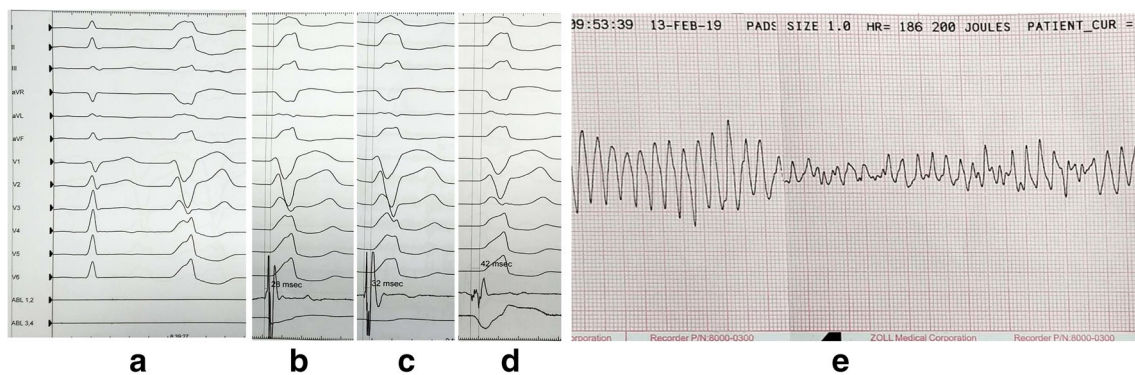


Fig. 5 Surface 12-lead ECG feature of this child; effective target site pacing and activation mapping using CARTO system. ① Spontaneous surface ECG features with sinus rhythm on the left and PVC on the right. ② The origin of the first plot. At the anterior septum of the RVOT, a QRS pattern similar to that of the surface 12-lead ECG was recorded. The starting point of the ventricular potential of the effective target site was 28 ms earlier than the onset of the QRS wave of the surface 12-lead ECG. ③ The origin of the second plot. A similar pattern was then recorded nearby the first plot, where the ventricular local potential was recorded

32 ms earlier than the surface ECG QRS wave. ④ Target of successful ablation. At the right pulmonary sinus valve where similar QRS patterns were recorded again, the ventricular local potential was recorded 42 ms earlier than the surface ECG QRS. ⑤ The site ablation was successful, which is shown in red in the CARTO mapping system diagram. ⑥ ECG characteristics of VF. VF characterized by tip torsion, triggered by R-ON-T, and recovered after 200 J unsynchronized cardioversion or defibrillation

All children underwent a 3-month postoperative electrocardiogram, the mean LVEF was $69.13 \pm 3.81\%$, significantly higher than before the operation ($P=0.012$). All three cases with LVEF of $< 55\%$ recovered during the review. The LVDD was 41.83 ± 4.93 mm, which was smaller than before surgery; however, the difference was not statistically significant ($P=0.182$). Among the seven cases with preoperative left ventricular enlargement, only one case did not return to normal (Table 2).

4 Discussion

RFCA was successful in 68 out of 75 children with PVCs, with a success rate of 90.67%. The recurrence rate during follow-up was low (2.94%). Our results were consistent with literature reports [7, 14]. There was only one case that had intraoperative complications, suggesting that the complications from RFCA were low. After the successful elimination of complications, no adverse reactions were observed in the long-term follow-up.

In clinical practice, PVCs is the most common type of arrhythmia in both healthy children with normal functioning hearts and children with organic heart diseases. Although many clinical trials have shown that the prognosis of most children with PVCs is good, there are still some children at risk of developing fatal arrhythmias such as VT and/or VF. Recently, studies have also shown that high-load PVCs may be a subclinical stage of cardiac dysfunction. Long-term high-load PVCs have an adverse effect on cardiac function that can lead to increased LVDD, decreased LVEF, cardiac insufficiency, and tachyarrhythmia-induced cardiomyopathy [15–17]. However, cardiac function of the children can be improved,

and cardiomyopathy can be reversed after RFCA. Our research showed similar findings. Before RFCA, some children showed PVC-related symptoms, such as chest tightness, palpitations, and post-exercise fatigue. Among them, two children strongly required surgery because of obvious symptoms. Therefore, they were treated with RFCA without using anti-arrhythmic drugs. Among the 75 cases, the preoperative echocardiography showed an average LVEF of $66.21 \pm 3.22\%$, with three cases having EF of $< 55\%$. The LVDD was 42.92 ± 5.99 mm, with seven patients showing varying degrees of left ventricular enlargement. These results suggest that high-load PVCs may lead to decreased cardiac function. Post-RFCA, symptoms disappeared. Re-examination with echocardiography 3 months postoperative showed LVEF of $69.13 \pm 3.81\%$, which was significantly higher than preoperative LVEF ($P=0.012$). All three patients with EF of $< 55\%$ returned to normal, and only one of seven patients with left ventricular enlargement did not recover. These results suggested that RFCA could effectively improve cardiac function in children. Postoperative LVDD was 41.83 ± 4.93 mm, which was slightly smaller than the previous one; however, the

Table 2 Changes of cardiac function before and after RFCA

	LVEF (%)	LVDD (mm)
RFCA preoperative	66.21 ± 3.22	42.92 ± 5.99
3 months after RFCA	69.13 ± 3.81	41.83 ± 4.93
P	0.012	0.182

RFCA, radiofrequency catheter ablation; LVEF, left ventricular ejection fraction; LVDD, left ventricular end diastolic diameter

difference was not statistically significant ($P = 0.182$). We assumed that it can be related to the short time of review.

With the development of cardiac electrophysiological technology, treatment through RFCA in adults with PVCs is efficacious and safe and has become the only definitive therapy [12]. However, its use on children is still worth discussing because the pediatric heart is still developing and the myocardial wall is thin. Presently, there is still lack of a large sample size thematic study on the use of RFCA for PVCs in children [18]. Long-term high-load PVCs can cause harm to children. Children who suffer from symptoms are at risk of tachyarrhythmia-induced cardiomyopathy. They also cannot participate in physical exercise normally, affecting their growth and development. Anti-arrhythmic drugs are only palliative, but are not definitive therapy. Long-term medication can also affect a child's sleep schedule and the quality of life. The parents and the children have to bear with this psychological burden for a long time.

The treatment of ventricular arrhythmia has become a much talked about and difficult topic in pediatric arrhythmia research. With RFCA, PVC-related symptoms disappeared after the surgery. The children did not need medications and participated in physical exercise normally, which greatly improved their quality of life, benefitting their physical and mental health. Therefore, RFCA is recommended for patients who weigh more than 15 kg, have symptoms, unable to tolerate long-term drug treatment or have no effect on their symptoms, and seriously affect their quality of life.

Akdeniz et al. [18] found that the common risks of RFCA failure for PVCs in children were male sex, origin site close to the His bundles, and epicardial origin. Our data were similar to their findings; five of the seven children with failed RFCA were male. We also analyzed the possible reasons for RFCA failure: children with multifocal origin; inability to find the critical ablation zone by using the traditional mapping method in an abnormal ventricular structure; high-risk localization of PVCs origin near the His bundle region; some origins are located in areas that are not accessible to ablation catheters, such as the epicardium and endocardium; insufficient preoperative assessment of PVCs in few patients who may have underlying conditions, such as structural heart disease and/or genetic dysrhythmia; failure to induce PVCs after anesthesia. Therefore, the key to improve the success of surgery is accurate preoperative evaluation and strict control of indications.

Currently, the complications of RFCA for ventricular arrhythmias in children are at 2.2% [19], and deaths are rare. The main complications are microvascular complications at the puncture site, such as arteriovenous fistula, second- or third-degree atrioventricular block, cardiac perforation, cardiac tamponade, and thromboembolism [20, 21]. Complications are mainly related to the operator's proficiency, the origin site of PVCs, catheter operation, and ablation technology [16, 17]. In this case, the origin site was determined to be in the RVOT

septum using pacing and excitation mapping. Intraoperative VF has been reported in adults [18], which has also not been reported in children. In this study, our results showed that VF occurred after 10 s of ablation, which may be related to mechanical catheter stimulation and increased local myocardial sensitivity during ablation. The child recovered after defibrillation. Subsequently, the QRS wave pattern similar to the 12-lead surface ECG was recorded under the right pulmonary sinus valve. The local ventricular potential was recorded 42 ms earlier than the QRS wave in the ECG, which was the target of successful ablation. In order to prevent the occurrence of complications, preoperative defibrillation preparations should be secured, including routine bounding of defibrillator electrodes, connection of defibrillators, and preparation of medications. Catheter insertion should be done carefully and gently; catheter tension should not be too high, and positioning should be accurate. From the start of intubation, the patient's ECG changes, and response should be closely monitored. Once paroxysmal VT is detected, local stimulation should be stopped, and the catheter position should be adjusted. Once VF occurs, immediate defibrillation should be performed. After successful ablation, there was no recurrence of PVCs during the postoperative follow-up, and cardiac function was normal. The key to eliminating complications is repositioning the catheter and finding a more accurate origin point.

We also found an interesting phenomenon. In the postoperative 48-h ECG monitoring, some children had recurrence of PVCs $< 1000/24$ h, and the QRS wave morphology was similar to that before surgery. However, upon follow-up 1 month after surgery, the dynamic ECG was reviewed, and it showed that those PVCs disappeared. To our knowledge, there are no similar reports found in literature. We hypothesized that the PVCs may have been due to the increased stress and local myocardial edema induced by intraoperative ablation. Long-term prognosis of the children will not be affected since the PVCs disappeared after the local myocardial edema subsided. Therefore, the occurrence of a few episodes of PVCs after surgery may not be too alarming; however, complete psychological comfort for the children and their families is necessary.

This paper also has some limitations. First, this is a single-center study; hence, it is not representative of other patient populations. Secondly, the number of cases in this group was not large, especially with few cases of VF. The follow-up time for the VF cases was only 3 months, which may not have been long enough. We recommend increasing the number of cases and extending the follow-up time. Additionally, the patient did not undergo cardiac nuclear magnetic resonance imaging; there was no quantitative assessment of the quality of life improvement after ablation; hence, long-term efficacy was not assessed.

In conclusion, RFCA in children is safe and effective with a low recurrence rate and few complications. Intraoperative VF

is rare, and may be related to mechanical stimulation of the catheter and increased local myocardial sensitivity during ablation. However, intraoperative VF is not an indication to cease surgery, and the key to eliminate complications is to reposition the catheter and find a more accurate origin point.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

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