

CATHETER RADIOFREQUENCY RF-ABLATION OF THE SLOW PATHWAY IN ATRIOVENTRICULAR NODAL REENTRY TACHYCARDIA (AVNRT), FIRST EXPERIENCE IN IRAQ

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ABSTRACT

Background

AVNRT is the most frequent type of regular paroxysmal Supraventricular Tachycardia (SVT). Catheter Radiofrequency Ablation (CRFA) has been recommended as first line therapy for curing AVNRT.

Objective

This prospective study was conducted at AL-Kadhimiya Teaching Hospital from January 2004 to July 2006 to report the 2 years experience of CRFA of the slow pathway in patients with recurrent attacks of AVNRT refractory to medical therapy treated at our Electrophysiology laboratory (EP Lab.) and assessed for success rate and recurrence rate after CRFA.

Patients And Methods

Fifteen patients selected after diagnosis of typical AVNRT and been considered as refractory to drug therapy when the full single or combined antiarrhythmic therapy gave poor control. AVNRT diagnosed when the superficial ECG and the EP study showed: a, regular narrow complex tachycardia. b, no p wave or short RP long PR .c, VA interval < 55 msc. d, dual AVN conduction and AH interval jump. CRFA done with the use of a standard EPS with three diagnostic catheters and one RF Ablation catheter . AVNRT induced either spontaneously or by programmed atrial stimulation . Ablation done during tachycardia in 11 patients and during sinus rhythm in four . Slow pathway ablation done using a combined electrophysiological and anatomical approach The primary endpoint of CRFA was termination and or non-inducibility of AVNRT.

RESULTS: Acute success was achieved in 15 patients (100%) . The total procedure time ranged from 30 minutes to one hour .The average fluoroscopy time was 10.5+ 4.5 minutes .The patients were followed up for a mean of 15+ 3 months during which there was only one case of recurrence cured by a second CRFA . Complete heart block is the only complication and seen in one patient who needed permanent pacemaker implantation.

Conclusion

CRFA of the slow pathway is highly effective in the treatment of AVNRT . The technique has high initial success rate and low complication rate. The recurrence rate is low. CRFA should be considered as first line therapy even in drug responsive patients with AVNRT.

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INTRODUCTION

Atrioventricular nodal reentry tachycardia (AVNRT) is the most common cause of recurrent regular supraventricular tachycardia (SVT). It accounts for 85% of regular SVT {1,2,3} and it is the most common mechanism of paroxysmal SVT in adults {2,3,4}. The mechanism of AVNRT is classically attributed to dual Atrioventricular (AV) nodal pathways physiology, including one pathway with relatively fast conduction but long antegrade refractoriness (fast pathway) and another slower conduction but shorter antegrade refractoriness (slow pathway). In most patients with AVNRT posterior atrio-nodal input to the AV node serves as the antegrade limb of the tachycardia reentry circuit and labeled as the slow pathway, and an anterior atrionodal input serves as the retrograde limb and called the fast pathway {4,6}. It has been demonstrated that the fast pathway conduction occurs superiorly in the region of His bundle recording, while the conduction over the slow pathway is projected inferiorly over the coronary sinus ostium region along the tricuspid valve annulus. {7} The impulses pass down the slow pathway and back up the fast pathway. Each time it passes through the lower turnaround point, it passes down to the ventricles giving heart rates usually in the region of 180-220 bpm. {7,8} Curative ablation of one of the two pathways in these patients with AVNRT is called AV nodal modification and usually involves interruption of the fast or the slow pathway. This leaves just one input into the AV node and so prevents any tachycardia initiation and recurrence. {7,9} AVNRT are of two main types: A, Typical, common type or short RP long PR tachycardia. This type constitutes 85% of AVNRT, the slow pathway is antegrade limb and the fast pathway is the retrograde one. Accordingly it is called slow-fast type. The P waves in the ECG are either not seen because the atria and the ventricles

are usually depolarized simultaneously or discrete P seen immediately after the R wave giving the character of short RP long PR to the tachycardia. {4,9,10} B, Atypical, uncommon or long RP short PR tachycardia. It constitutes about 15% of AVNRT. The fast pathway is the antegrade limb, and the slow pathway is the retrograde limb of the tachycardia circuit. So it is called fast-slow type. The P waves precede each QRS complex and inverted in the inferior leads giving the feature of long RP short PR. {4,10} The short term therapy during the tachycardia depends on the tachycardia tolerated by the patient, in well tolerated status can be terminated by vagal maneuvers including: carotid massage, Valsalva maneuver, eye ball pressure and applying ice to the face in children. {8,11}. Poorly tolerated tachycardia requires immediate cardioversion by i.v. Adenosine, i.v. Verapamil, i.v. B-blockers, i.v. Disopyramide, i.v. Amiodarone, i.v. Ibutilide, i.v. Propafenone, i.v. Flecainide or DC-cardioversion. {12,13,14}. The possible negative antiarrhythmic hypotensive, bradycardia and proarrhythmic effects should be considered. {12,13} Long term therapy for patients with recurrent episodes should primarily receive AV node blocking agents such as verapamil, B-blockers {13}. Clinical experience indicates that these agents decrease frequency of attacks and reduce severity of symptoms in 30-60% but complete remission is unlikely. {13}. Amiodarone prevents recurrence in up to 80%. {14}. Long term therapy with these drugs exposes the patient to many side effects {12}. Catheter ablation is usually preferred if the patient agrees to this approach. {9,15}. Either form of AVNRT can be eliminated by radiofrequency ablation of either the fast or the slow pathway {16}. The fast pathway approach carries much higher risk of developing complete heart block because of His bundle injury due to its near site to the fast pathway {16}. This complication occurs less with slow

pathway ablation because its location is far from the His site.{17,18,19,20}

Catheter ablation is defined as the use of an electrode catheter to destroy small areas of myocardial tissue or conduction system or both that are critical to the initiation or maintenance of the arrhythmia. Arrhythmias most likely to be amenable to cure with catheter ablation are those which have a focal origin or involve a narrow , anatomically defined isthmus and pathways.{16,21}

Radiofrequency current is an alternating current that is delivered at a cycle length of 300 to 750 kHz when used for catheter ablation .Typical ablation catheters which are 2.2 mm in diameter (7 French) and have a distal electrode of 4 or 8 mm long , create lesions approximately 5-6 mm in diameter and two 2-3 mm deep(20) .Larger lesions are possible with larger electrode or saline irrigated ablation catheters .{22} The primary mechanism of tissue destruction by radiofrequency current is thermal injury{23} .Irreversible tissue destruction requires a tissue temperature of approximately 50 C .{24} In most ablation procedures , the power output of the radiofrequency generator is either adjusted manually or automatically to achieve a temperature of 60 to 75 C at the electrode –tissue interface.{24,25}. This is the first report from Iraq of catheter radiofrequency ablation (CRFA) of AVNRT and for any other arrhythmia, It has been introduced to the cardiology practice in the country by the team of the newly established EP laboratory in the Kadhimiya Teaching Hospital (KTH).

PATIENTS & METHODS

From January 2004 to July 2006 , a total of 15 patients with AVNRT has been selected for CRFA at KTH . The mean age of patients was 46.8+₋ 15 years (range 24-55) , 10 female and 5 male. The main symptom were palpitation in 100%, dizzy spells encountered in 35% and presyncope in two patients. The

indication of CRFA was failed pharmacological therapy either because of lack of drug efficacy or unacceptable side effects , or patient preference for CRFA over life long drug therapy. All patients underwent basic electrocardiogram (ECG) in sinus rhythm (SR) and all ECG records during the tachycardia were carefully inspected .The diagnosis of AVNRT were highly suspected when the following ECG signs are seen: a, narrow QRS regular tachycardia , b, P" either not seen in 5 patients because it is embedded within the QRS or seen after the QRS , c, short RP long PR character or type (common, typical AVNRT) in all patients .

ELECTROPHYSIOLOGY STUDY (EPS)

The procedure of EPS was performed in our catheter laboratory using Bard system (CR Bard, IAC, USA) and Radionics stimulator. Each patient gave a written consent for EPS and ablation .All antiarrhythmic drugs omitted for a period of at least two weeks or five half lives.After skin sterilization and 2% lidocaine used for local anesthesia of the left and right inguinal areas . A 3-4 catheters approach was used , through femoral vein puncture venous sheaths were put and under fluoroscopy the quadripolar catheters positioned in the high right atrium (RA) , the His bundle and the right ventricle (RV) .Coronary sinus catheters used in few patients if deemed needed. Ablation catheter was introduced after the EPS and decision of CRFA is decided. The basic Electrophysiology intervals were recorded in SR ,then induction of tachycardia was attempted using programmed atrial stimulation (PAS) or programmed ventricular stimulation (PVS) at two driving cycle lengths and up to two extrastimuli at 10 msc. decrements until tachycardia induction . Spontaneous initiation of tachycardia occurred in nine patients. Two or three surface ECG and intracardiac

electrogram (EGM) were recorded and saved on optical disc during the EPS. The EPS criteria for diagnosis of dual AVN physiology, and AVNRT were used : (1) The presence of AV jump of 50 msc and above and AVN reentrant echo beat was ascertained followed by AVNRT induction. (2) VA interval during AVNRT at His position was less than 60 msc. see Figure 1. The tachycardia was induced and terminated by overdrive pacing or CRFA at least once.

CATHETER RADIOFREQUENCY ABLATION

Under fluoroscopy radiofrequency ablation catheter (EPT catheters ,Daig St Jude Medical {SJM} , USA) was positioned in the posteroinferior aspect of the tricuspid valve annulus for ablating the slow pathway of the AVNRT .We used the anatomic approach of Jazayeri in which a step-wise positioning of the ablation catheter from low in the triangle of Koch to more superior areas were used .If we are ablating in SR the mapping (ablation catheter) electrodes were examined for good ablation signals which are : large ventricular signal and small atrial signal with a ratio of about 5:1 was obtained and then radiofrequency (RF) energy was delivered at that site through a RF generator from Radionics (Freiburg, Germany). Appearance of junctional rhythm during the first 30 sec. of RF delivery is an indication of successful RF delivery and a total time of energy delivery of 120 seconds is done. The ablation catheter tip temperature was always maintained from 50° C to 60° C with power of 30-40 watts. When junctional rhythm did not appear within first 30 seconds of the current delivery , the application was stopped and repeated .This occurred in two patients .After successful RF ablation, patients were checked for evidence of persistent AV nodal pathway and inducibility of the tachycardia by

repeated APS and another RF lesions delivered for 60 seconds at the same site. patients in whom tachycardia is inducible after two lesions ,the ablation catheter is positioned in a more mid septal position and another lesion is given till inducibility is not possible. The endpoint for success was non inducibility of AVNRT which means slow pathway has been ablated .An AH jump with APS of at least 50 msc. with or without echo beat may persist but does not indicate inducibility of the tachycardia. Post procedure ,patients were observed for four hours on rest after which they were mobilized .They were discharged from the hospital after 24 hours. The patients were followed up on outpatient every month after the procedure . They were asked about recurrence of palpitation due to episode of tachycardia or other symptoms . A 12 lead ECG done and all antiarrhythmic drugs were avoided .

RESULTS

The total number of patients included in this study were 15 patient during the period from January 2004-July 2006,their age range was 25-55, mean 40 +_ 11 10 females and 5 males . The commonest symptoms in descending order of frequency were :palpitation in (100%),dizziness (60%), syncope (20%), Dyspnea in 40%, and chest pain in (20%). Associated heart disease was found in two patients and 13 patients had no structural heart disease. The indication of CRFA was ineffective drug therapy in 13 and sever drug side effects in one and patient preference in one. All the patients were of the typical short RP long PR type. During the procedure AVNRT could be induced spontaneously in 9 and by APS in 6. All the patients (100%) was successfully ablated. The average procedure time was 72+_ 21 minutes. Fluoroscopy time was 10+- 5.4 minutes. Average number of RF pulses delivered was 5.5+- 4.1. Complication rate : complete heart block requiring permanent pacemaker insertion in one

patient only and transient moderate vasovagal episode in one patient. The total period of follow up ranged from 1.5- 2 years .There was only one recurrence after six months which was ablated by a second procedure .

DISCUSSION

AVNRT accounts about 85% of regular SVT {1,5,7} ,occurs more in females and at age of 42-55 years{4,5,7}.In this study 67% are woman and the age range is 40 +-11.3 which is rather younger than previous reports. Wood described that the common symptom is palpitation seen in 96% , dizziness 75%, Dyspnea 47%, and syncope (0.5%) {8}. We noticed palpitation in 100% , dizziness in 60%, syncope in 20% and Dyspnea in 40% . AVNRT is commonly seen in structurally normal heart and structural heart disease seen in 6-19.5% in many series {5,6,7,8} in this study found it in 13%. The typical type of the AVNRT is the far more common than the atypical type {2,6}.In our study all the 15 patients are of the typical (common) type. The treatment of AVNRT depends mainly on the effect of the tachycardia on the haemodynamic and life activities of the patient. Finding a cure has always been a goal of therapy{7,12}. Pharmacological treatment might well be very effective in some patients and might be not so helpful in others and always there are cases in between the two. Patient compliance to drug therapy and side effects of the drug are two limiting factors of the needed life lasting therapy . When ablation therapy first used by delivering DC- shock or open heart surgical therapy it gave a hope for future easier ,safer and highly successful ablation procedure and that is when CRFA developed well and the energy source of RF became so well controlled and refined the results of CRFA became highly encouraging to achieve total cure of many arrhythmias and AVNRT is in the top of the list of those curable arrhythmias by CRFA due to the development of anatomical and

electrical mapping procedures and precisely defining the ablation site.{9,10,15,17} To obtain highly successful CRFA procedure you need: a, well set EP system. b, reliable X-ray fluoroscopy. c, trained medical and technical staff . In AVNRT the EP diagnosis of AVNRT type, differentiating it from other SVTs and choosing the exact ablation site are the main factors which help to obtain high success rate {18}. In Kadhimiya teaching hospital we started CRFA with two screen ground based fluoroscopy , Bard EP system, and Radionics stimulator and RF generator, locally educated technical staff who had no previous experience in EPS and the training for RFCA of the chief cardiologist was through available internet and other educational tools , no personal training program became available to us neither locally or abroad . It is totally self education process . CRFA of the slow pathway is highly successful and safe{24}.Our success rate with our small number is 100%. The high success rate of our study is due to careful selection of patients, being typical AVNRT and dedicated work. Small number of patients included in this study is another factor in high success rate and considered a limitation to our study.The appearance of junctional rhythm (JR) during CRFA is considered a marker for successful RF delivery and slow pathway ablation by some authors {16,18,20} see Figure 1. However the absence of JR does not increase the risk of recurrence but technically it well indicate unreliable delivery of RF energy.{22,23,24} The first site of RF energy delivery in our study was selected by both using fluoroscopy guidance (anatomical approach) and good ablation signals (electrical approach) .If the first RF lesion did not produce JR the delivery stopped after 30 seconds and evidence of persistent AV nodal dual pathway and inductility of the tachycardia is tested .Two patients did not develop JR in our study which is compared to others {17} .

CRFA improves health-related quality of life to a greater extent than do medications and less expensive therapy as compared to long life lasting drug therapy among patients who have monthly episode of AVNRT{16,18}. Results from this and other studies has shown that CRFA to be both safe and effective supporting to consider CRFA therapy as first-line therapy for the majority of patients with AVNR {24}. The occurrence of AVB which seen in two patients (13%) is higher than other series is due to our early experience and it occurred in the first and fourth patient .{17} The recurrence rate after successful ablation is very low it ranges from 3-6% {16,24}.In our series only one patient had recurrence after six months and needed a second procedure with no more recurrence after a year of follow up. Histological studies showed that acute ablation lesions are composed of central coagulation necrosis , surrounded by hemorrhage and interstitial edema .Conduction may resume following settling of edema and

inflammation after thermal injury ,predisposing for AVNRT recurrence within few days to months after ablation.{18,21} In conclusion this study demonstrated in a small series of patients that slow pathway CRFA is highly efficacious in treatment of AVNRT and can be considered as first line therapy and is associated with low risk of complications .The recurrence rate is low. We recommend that CRFA can be more widely applied in treatment of AVNRT with poor response to drug therapy and according to patient preference over drug therapy in good responders . The limited number of patients in this study is due to been the first experience in Iraq, the CRFA is not understood well by many physicians and its availability is not known which resulted in limited referral of patients .Better understanding and more orientation of physicians of the value of CRFA as a treatment for AVNRT can be achieved through conferences and educational programs .

Figures

Figure 1: AVNRT initiation and Electrophysiological features, note the AH jump phenomenon and the Echo beat appeared before the initiation of the AVNRT.

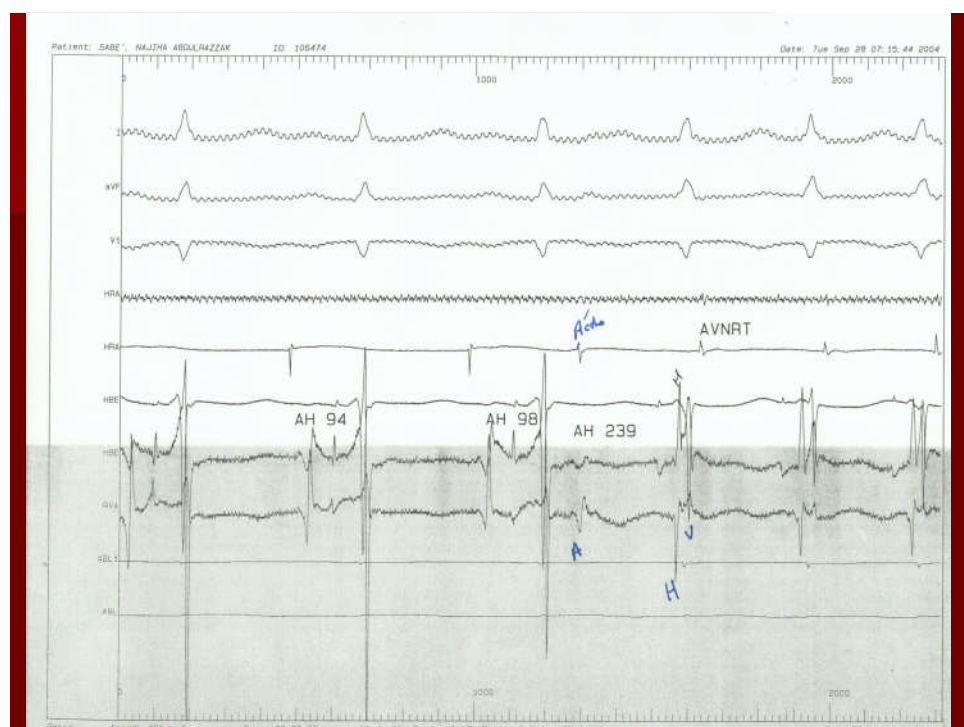


Figure 2, Electrophysiological trace showing reversion of AVNRT in to sinus rhythm with Rf –Ablation,note the appearance of junctional rhythm just before reversion.

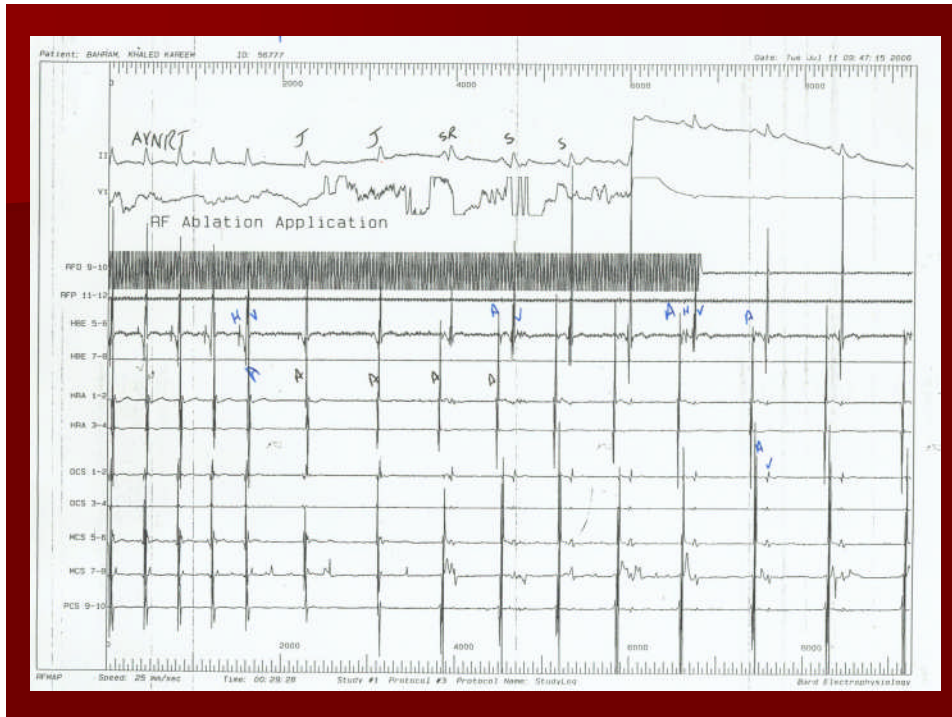
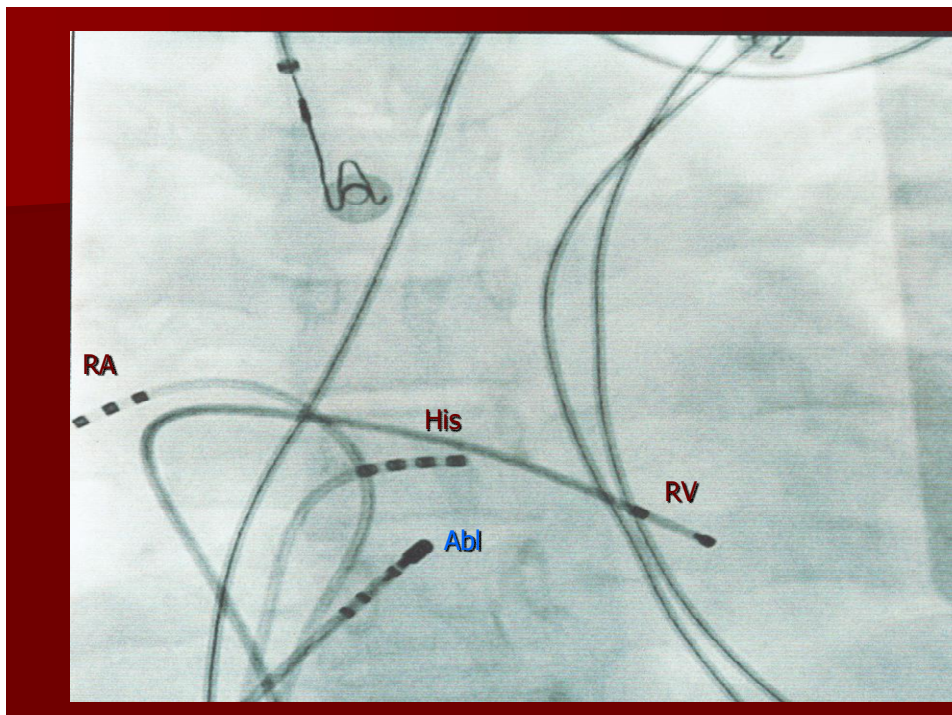


Figure 3, X-ray showing the RA, His ,RV and the RF-Ablation catheter position during CRFA of the AVNRT



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المحي الراديوي القسطاري للمسرى البطيء في التسارع التداخلي للعقدة الأذينية البطينية (AVNRT)

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الخلاصة

الخلفية: التسارع التداخلي للعقدة الأذينية البطينية (ت ت ع ذ ب) هي أكثر أنواع التسارع اللانظمي الأذيني المنتظم شيوعاً. المحي الراديوي القسطاري (م ر ق) قد زكي كعلاج اولي لشفاء ت ت ع ذ ب .

الهدف: هذه الدراسة قد أجريت في مستشفى الكاظمية التعليمي بدءاً بكانون ثاني ٢٠٠٤ حتى حزيران ٢٠٠٦ لأستعراض الخبرة العملية لمدة سنتين في علاج ت ت ع ذ ب باستخدام المحي الراديوي القسطاري للمرضى الذين فشل العلاج بالعقاقير في السيطرة على نوبات ت ت ع ذ ب .

المرضى و طريقة البحث: خمسة عشر مريضاً أختيروا بعد تشخيص ت ت ع ذ ب المثالية العسية على العلاج بالعقاقير . شخضت ت ت ع ذ ب عندما أضهرا تخطيط القلب و الدراسة الكهروفسلجية :أ، تسارع منتظم ضيق ال QRS، عدم وجود موجة P أو ظهور RP قصيرة PR طويلة.ج، فترة VA أقل من ٥٥ ملثانية.د، توصيل AV Nodal ثنائي و طفرة فترة AH. م ر ق أجري بواسطة استعمال ثلاث قسطرات كهروفسلجية و قسطرة محي راديوي واحدة. ت ت ع ذ ب انشأت أما تلقانياً أو بواسطة التحفيز الأذيني المبرمج. م ر ق أجري أثناء التسارع في ١١ مريضاً و أثناء النبض الطبيعي في أربعة مرضى. محي المسرى البطيء أجري باستعمال طريقة الكهروفسلجة و التشريح المزدوجة. النتيجة النهائية الأولية لل م ر ق هي انهاء و عدم انشاء ال ت ت ع ذ ب .

النتائج: حصل على النجاح المباشر في ١٥ مريضاً (١٠٠%) . الوقت الكلي للعملية تراوح بين ٣٠ دقيقة الى ساعة . معدل وقت الأشعاع كان ٤,٥ + ١٠,٥ دقيقة. توبع المرضى لفترة زمنية قدرها ٣-١٥ شهراً ،خلالها كانت هنالك حالة رجوع ت ت ع ذ ب واحدة فقط شفيت ب م ر ق ثان.الأحصار القلبي التام هو الأختلاط الوحيد و حدث في مريض واحد الذي احتاج زرع منظم القلب الدائمي.

الاستنتاج: م ر ق للمسرى البطيء فعال جدا في علاج ت ت ع ذ ب .التقنية هذه أظهرت نسبة نجاح عالية و نسبة اختلاطات واطنة. م ر ق يجب ان يؤخذ به كعلاج اولي في علاج ت ت ع ذ ب حتى في المرضى الذين يستجيبوا للعقاقير.

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