Good Things Come To Those Who Wait? Adenosine Administration versus a Waiting Period after Cavo-Tricuspid Isthmus Radiofrequency Ablation.

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Abstract

Aims: To investigate the utility of adenosine administration to test the durability of cavotricuspid isthmus (CTI) block after radiofrequency (RF) catheter ablation for typical atrial flutter. Methods: Adenosine 10mg was administered by bolus injection through a femoral sheath at 5 minutes after apparent completion of CTI ablation in consecutive patients, and its effect on CTI conduction was recorded. Conduction in both directions across the CTI was tested repeatedly until 20 minutes after the last energy delivery. Results: Among 132 patients treated with a Blazer 10mm (n=126) or 8mm (n=6) ablation catheter, bidirectional block of the CTI was achieved in all cases. Adenosine administration was followed by a transient recurrence of conduction in 3 cases (2.3%); in all of these, a persistent recurrence of CTI conduction was observed within the waiting period. Persistent recurrence of CTI conduction occurred within the waiting period in 3 patients (2.3%) whose adenosine test had been negative. In all cases, further RF delivery achieved CTI block that persisted to the end of a 20-minute waiting period. During 38 months of follow-up, 131 patients (99.2%) remained free of clinical recurrence of typical flutter. Conclusion: Administration of adenosine 10mg at 5 minutes after RF delivery reveals latent conduction in the CTI in some but not all cases that are revealed by a 20-minute wait. At this dosage and at this time-point, adenosine testing is not an adequate substitute for a waiting period.

INTRODUCTION

Ablation of the cavo-tricuspid isthmus (CTI) to produce persistent bidirectional block is the treatment of choice for typical atrial flutter,[1] making it one of the most common procedures in cardiology. Because the conduction block produced by radiofrequency (RF) energy can be reversible, it is usual to wait for a period of 20-30 minutes after the achievement of CTI block before the procedure is concluded.[2] This waiting period adds to the duration of the procedure, and therefore to its cost.

Administration of adenosine or of adenosine triphosphate (ATP), originally used to demonstrate residual accessory pathway conduction by blocking atrioventricular nodal conduction,[3] was subsequently noticed to reawaken conduction in some pathways blocked by RF delivery.[4] This transient recurrence was predictive of a subsequent persistent recurrence of conduction. Similar resurrection of dormant conduction has been shown for block between pulmonary veins and the atrium after RF isolation,[5]and between an isolated superior vena cava and the adjacent right atrium.[6] The effect is believed to derive from adenosine induced resting-potential hyperpolarization which reverses the depolarisation that characterises RF-induced injury.[7]The

same phenomenon occurs after CTI block,[8] so adenosine testing has been proposed as a substitute for the traditional waiting period.[9]

METHODS

Consecutive patients undergoing CTI ablation in the absence of any other ablation target received a bolus injection of adenosine 10mg via a femoral venous access sheath at 5 minutes after the apparent achievement of persistent bidirectional CTI block. All patients were treated by the same operators in 2 centres. All procedures were performed under local anaesthesia using right femoral venous access and using fluoroscopic guidance to place a deflectable diagnostic catheter in the coronary sinus and a multipolar catheter in the lateral right atrium. A Blazer large-curve 8mm or 10mm tip ablation catheter was used to create a line of lesions to block the CTI and to perform consolidating lesions to create a clear zone of abolition of local electrograms.

After achievement of satisfactory CTI block, a waiting period was commenced. At 5 minutes into the waiting period, intravenous adenosine 10mg was administered centrally. The patient observations were monitored, the surface electrocardiogram and intra-cardiac electrograms were assessed for both evidence of adenosine-induced AV block and for transient re-conduction of the CTI. Further RF ablation was performed for all those who had persistent CTI conduction recurrence. For all those who required re-ablation to achieve enduring CTI line block, a full waiting period was respected, with no re-testing with adenosine.

RESULTS

We performed ablation for atrial flutter without ablation for other arrhythmias on 132 patients between October 2013 and September 2018. All received an adenosine test at 5 minutes. The test resulted in transient recurrence of clockwise conduction across the CTI in 3 patients (2.3%), all of whom went on to have a persistent recurrence of bidirectional conduction across the CTI at 6-10 minutes respectively. An additional 3 patients had persistent recurrence of CTI conduction at 17-19 minutes despite having had a negative adenosine test.

DISCUSSION

In this study, an adenosine test of 10mg at 5 minutes after RF ablation gave 50% sensitivity for identifying the 4.6% of cases in which CTI conduction would recur later in the 20-minute waiting period. A negative adenosine test gave 97.7% probability that conduction would not recur within this period. In no case was a positive adenosine test followed by continuance of CTI block to 20 minutes after ablation.

Optimum waiting time after CTI ablation

It is conventional to use a waiting time of at least 20 minutes after CTI ablation, but there is variation between centres in the exact interval chosen, with many centres choosing 30 minutes and some as long as 60 minutes. All studies on the time-course of conduction recurrence show an exponential decline in the probability of recurrence as time elapses from the last RF delivery.[2,10] Our choice of a 20-minute interval was based on pre-existing routines in our centres, which are in turn based on a pragmatic trade-off between the pressures of a busy and poorly funded system and the desire to keep our rate of permanent clinical cure close to 100%.

Adenosine dosage and administration

In a landmark evaluation of the electrophysiological effects of adenosine, DiMarco et al.[11] showed that the production of AV block required a mean dosage of 179 + 88 μg/kg. When used to terminate supraventricular tachycardias, adenosine is given by rapid intravenous injection, typically through a cannula in a peripheral vein at an initial dosage of 6mg, progressing in steps to a maximum of 18mg.[12] Testing for dormant conduction after pulmonary vein isolation predicts reconnection and facilitates the achievement of permanent block.[13] A range of adenosine dosages has been applied, mostly in the range of 12-30mg. In many cases, an initial dose of 12mg was followed by higher doses if atrioventricular block was not produced initially, but Kumagai et al used a dosage regime equivalent to ours.[14]

A previous evaluation of adenosine testing after CTI ablation by Morales et al[9] using a dosage of 0.2mg/kg with a minimum of 12mg administered immediately after achievement of CTI block recorded a false negative rate of 1.2% in predicting durability of block to 30 minutes.

Safety and tolerability of adenosine

Despite very widespread use in an emergency-room setting for the acute management of supraventricular tachycardia, there are very few reports of significant adverse effects and none in a meta-analysis of randomised trials.[15] Unfortunately it produces unpleasant chest tightness in most patients, tolerable as a single experience but increasingly unpleasant with repetition. This makes a single bolus preferable to a regime of escalating doses. The single-dose 10mg protocol used in this series was tolerated without difficulty by all patients who received just light sedation. As PVI is generally performed under general anaesthesia or deeper sedation, higher doses of adenosine or escalating dosage regimes are easily tolerated.

Potential benefit of adenosine testing

Adenosine testing could be performed at the end of a standard waiting period to further augment the already high rate of permanent cure of atrial flutter, as it is used after PVI. This study tested its ability to replace the waiting period. If we had terminated the waiting period after each of the 128 negative adenosine tests, the procedure duration would have been reduced from 42±12 to 27±12 minutes, a 36% time-reduction.

Limitations of adenosine testing

The rate of long term clinical cure of atrial flutter in most modern series, including the current one exceeds 98%. This context makes the observed failure rate of early adenosine testing of 2.3% in our series and the 1.2% failure rate recorded by Morales et al highly significant. With such a high rate success easily available, acceptance of anything less than certainty in the permanence of block would be unsatisfactory. The regime that we used does not meet this standard; a higher dosage, or a dosage regime tailored to the patient's weight or to the effect on atrioventricular conduction would be worth evaluating.

STUDY LIMITATIONS

This study has addressed just one dosage and one time point for adenosine testing. Administration of a larger dose or performance at a later time point might provide a test reliable enough to curtail the waiting period without compromising the very high rate of long-term clinical success that is now observed routinely.

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