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Original Article

Renal sympathetic denervation in patients with implantable cardioverter-defibrillator and electrical storm

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ABSTRACT

Background: Implantable cardioverter-defibrillators (ICDs) are usually indicated for patients with malignant arrhythmias considered as high risk. Sympathetic hyperactivity plays a critical role in the development, maintenance, and worsening of ventricular arrhythmias. New treatment options in this population represent a clinical necessity. This study's objective was to report the outcomes of patients with ICDs and electrical storm submitted to renal sympathetic denervation for arrhythmia control.
Methods: Eight patients with ICDs admitted for electrical storm refractory to optimal medical therapy underwent renal sympathetic denervation. Underlying diseases included Chagas disease (n = 6), non-ischemic dilated cardiomyopathy (n = 1), and ischemic cardiomyopathy (n = 1). Information on the number of episodes of ventricular tachycardia/ventricular fibrillation and antitachycardia therapies in the week before the procedure and 30 days after treatment were obtained through interrogation of the ICDs.
Results: The median numbers of episodes of ventricular tachycardia/ventricular fibrillation, antitachycardia pacing, and shocks in the week before renal sympathetic denervation were 29 (9 to 106), 23 (2 to 94), and 7.5 (1 to 88), and significantly reduced to 0 (0 to 12), 0 (0 to 30), and 0 (0 to 1), respectively, 1 month after the procedure ($p = 0.002$; $p = 0.01$; $p = 0.003$, respectively). No patients died during follow-up. There were no major complications related to the procedure.
Conclusions: In patients with ICDs and electrical storm refractory to optimal medical treatment, renal sympathetic denervation significantly reduced arrhythmia load and, consequently, antitachycardia pacing and shocks. Randomized clinical trials in the context of renal sympathetic denervation to control refractory cardiac arrhythmias are needed to further support these findings.

Denervação simpática renal em pacientes com cardiodesfibrilador implantável e tempestade elétrica

Palavras-chave:
Artéria renal
Ablação por cateter
Arritmias cardíacas

RESUMO

Introdução: Cardiodesfibriladores implantáveis (CDIs) são geralmente indicados para pacientes com arritmias malignas considerados de alto risco. A hiperatividade simpática desempenha um papel crítico no desenvolvimento, na manutenção e no agravamento de arritmias ventriculares. Novas opções de tratamento nessa população representam uma necessidade clínica. Nosso objetivo foi relatar os resultados de pacientes com CDIs e tempestade elétrica submetidos à denervação simpática renal para controle da arritmia.
Métodos: Oito pacientes com CDIs internados por tempestade elétrica refratária ao tratamento médico otimizado foram submetidos à denervação simpática renal. Condições subjacentes foram: doença de Chagas (n = 6), cardiomiopatia dilatada não isquêmica (n = 1) e cardiomiopatia isquêmica (n = 1). As informações sobre o número de taquicardias ventriculares/fibrilações ventriculares e episódios de terapias antitaquicardia na última semana pré-procedimento e nos 30 dias pós-tratamento foram obtidas por meio de interrogação dos CDIs.
Resultados: As medianas dos episódios de taquicardias ventriculares/fibrilações ventriculares, sobre-estimulação e choques na semana que antecedeu a denervação simpática renal foram de 29 (9 a 106), 23 (2 a 94) e 7,5 (1 a 88), sendo significativamente reduzidas para 0 (0 a 12), 0 (0 a 30) e 0 (0 a 1), respectivamente, 1 mês

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após o procedimento (p = 0,002; p = 0,01; p = 0,003). Nenhum paciente morreu durante o acompanhamento. Não ocorreram complicações maiores relacionadas ao procedimento.
Conclusões: Em pacientes com CDIs e tempestade elétrica refratária ao tratamento médico otimizado, a denervação simpática renal reduziu significativamente a carga de arritmia e, consequentemente, as sobre-estimulações e os choques. Ensaios clínicos randomizados, no contexto de denervação simpática renal para controle de arritmias cardíacas refratárias, são necessários para trazer maior robustez aos nossos achados.

Introduction

Implantable cardioverter-defibrillators (ICDs) have shown to be effective in primary and secondary prevention of sudden cardiac death and are usually indicated for patients with malignant arrhythmias considered as high risk.[1] Electrical storm is defined as the occurrence of three or more episodes of potentially malignant ventricular arrhythmias (VAs) within a 24-hour period, whose reversion requires intervention with antitachycardia therapy, i.e., antitachycardia pacing (ATP) or shock. This is a severe and dramatic event when repeated shocks are required, a fact that leads to hospital admission at the intensive care unit, causing considerable discomfort to patients in addition to premature ICD battery wear. The therapeutic options for patients with recurrent ICD shocks include drug treatment with antiarrhythmics and beta-blockers,[2-4] and catheter ablation.[5,6] However, both approaches are associated with low efficacy in the long term, and in case of ablation, it may be associated with potential complications.[7] New treatment options in this population of high-risk patients represent a medical necessity.

Sympathetic hyperactivity plays a critical role in the development, maintenance, and worsening of VAs.[8] Percutaneous renal sympathetic denervation (RSD) has shown to reduce sympathetic activity[9] and, therefore, decrease blood pressure in patients with resistant hypertension for up to 3 years of follow-up in some studies.[10-12] The effects of RSD on the sympathetic nervous system activity suggest that this technique can be used in other diseases associated with increased sympathetic tone, such as chronic renal disease, heart failure, and cardiac arrhythmias.[13] Particularly for the treatment of cardiac arrhythmias, RSD has a strong physiopathological rationale.[14] Recently, some case reports have suggested RSD benefits in patients with electrical storm.[15,16] However, data are scarce and any conclusive analysis regarding this context is compromised.

This study aimed to describe the results up to 30 days after RSD in patients with ICD and electrical storm refractory to optimal medical treatment.

Methods

Sample

This was a prospective study conducted at Instituto Dante Pazzanese de Cardiologia, a single tertiary hospital in São Paulo, Brazil. The study was approved by the local Ethics Committee and performed according to good standards of clinical practice. All patients read, understood, and signed the Informed Consent, which contained the most important information on the research protocol presented in an instructive summary.

Thirteen consecutive patients admitted with VA refractory to optimal medical therapy and considered unsuitable for cardiac ablation were eligible for the study, between August 2013 and June 2014. Diagnostic confirmation of electrical storm was attained through device interrogation, by means of the analysis of the stored intracardiac electrograms and confirmation that the antitachycardia therapies were appropriate and effective (Fig. 1). Electrical storm was defined as the occurrence of three or more episodes of sustained ventricular tachycardia (VT)/ventricular fibrillation (VF) within a 24-hour period, whose reversion required ATP or shock. Duration longer than 30 seconds and/or hemodynamic instability defined sustained ventricular tachycardia. Optimal medical treatment comprised the control of possible triggering causes of VA, such as electrolyte disturbances and the use of antiarrhythmic drugs. Cardiac ablation was qualified as inadequate in the presence of polymorphic VT, VF, unstable arrhythmias, non-mappable arrhythmias, intracardiac thrombus, or failure of previous ablation.

Exclusion criteria included the following: active infection, significant hypotension (systolic blood pressure ≤ 90 mmHg or need for vasopressor agents), renal failure (glomerular filtration rate - GFR < 45 mL/min) and renal arteries anatomically inadequate for intervention (< 20 mm long or < 3.5 mm in diameter, presence of > 50% stenosis/fibrodysplasia/previous stent), or a solitary kidney.

The ICD monitoring zone was programmed between 120 and 130 bpm in all patients. Information on the number of VT/VF episodes and antitachycardia therapies (ATP and shocks) in the week before the procedure and 30 days post-treatment were obtained through ICD interrogation.

Renal sympathetic denervation procedure

RSD was performed as previously described.[17] After obtaining femoral artery access, unfractionated heparin was administered at a dose of 100 IU/kg. Aortography along the renal arteries was performed with a pigtail catheter, followed by catheterization and selective renal arteriography using a Judkins catheter, after nitroglycerin administration (50 to 200 mcg). In all cases, the procedure was conducted using an irrigated tip radiofrequency ablation catheter (Therapy Cool Path™; St. Jude Medical™ – Minneapolis, USA). At least four radiofrequency (RF) lesions were made along both renal arteries, from the distal segment toward the ostia. The catheter was retracted 5 mm and turned after each radiofrequency application, thus producing a helical pattern of ablation. Due to the visceral pain caused using the ablation, analgesia was provided using fentanyl and morphine. At the end of the procedure, renal arteriography was performed to evaluate vascular integrity.