

Skin Burn at the Site of Indifferent Electrode after Radiofrequency Catheter Ablation of AV Node for Atrial Fibrillation.

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Abstract

Radiofrequency Ablation of AV node with permanent pacemaker has been used to achieve rate control in persistent symptomatic atrial fibrillation. Although RF Ablation is safe, complications may occur in up to 3% of the procedures. A rare complication of 2nd degree skin burn at indifferent electrode site has been described here. This report highlights the rare but possible complication in patients undergoing such a procedure and help in preventing by taking appropriate measures.

Introduction

Radiofrequency (RF) energy is a low voltage high frequency electrical energy which produces controlled focal tissue ablation. It has revolutionised the treatment of refractory supraventricular tachycardias. Although radiofrequency catheter ablation (RFCA) is a safe procedure, application of RF energy is not without complications. Major complications may occur in up to 3% of patients undergoing RFCA which includes AV block, Cardiac tamponade, Coronary artery spasm, thrombosis, Pericarditis, Vascular Injury, Thromboembolism, Transient ischemic attack and or stroke, Pulmonary hypertension secondary to pulmonary vein stenosis, Pneumothorax, Left atrial-esophageal fistula and Phrenic nerve paralysis¹. Most of the complications of RF ablation of supraventricular arrhythmias are limited to the site of RF energy application

and skin burn at the indifferent electrode site was described in only case secondary to maladhesion² of the electrode pads. We present a case of skin burn at the site of indifferent electrode after an elective RF ablation for recurrent AF.

Case Report

A 54 year old white obese woman (BMI 43) with 8 year history of symptomatic paroxysmal atrial fibrillation was referred for AV nodal ablation and permanent pacemaker insertion. Her past medical history is significant for hypertension and aortic valve replacement (#19 St. Jude Prosthetic valve) for congenital bicuspid aortic valve 9 years ago. She had multiple cardioversions and was treated with multiple antiarrhythmic drugs to achieve rhythm restoration. But AF remained unresponsive and she was symptomatic with fatigue, dys-

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pnea and congestive heart failure secondary to rapid ventricular response. She underwent radiofrequency catheter ablation and pulmonary vein isolation without any complications. But her AF recurred and was thought to be due to severely dilated left atrium with extensive scarring from both Aortic Valve replacement and RF ablation. She was recommended RF ablation of AV node with permanent pacemaker placement. She underwent the AV Nodal ablation under sedation, using the 8.0 mm Biosense Webster Celsius catheter (50 Watt and 50 C Temp). The bundle of His was successfully mapped and AV node was ablated with no ventricular escape. The total time of RF energy delivery during the ablation was about 6 minutes. No impedance raise was noticed during the procedure. After successful ablation, skin, under the indifferent electrode pad on the lower abdominal wall, was noted erythematous with second degree thermal burn (Fig. 1) at the leading edge of the pad. The adhesion between the pad and skin was checked thoroughly and was in good contact. There was no fluid around or in between the pad and skin. The patient did not

complain any pain during the procedure. The skin lesion became necrotic with scabbing and turned out to be a third degree burn over next few days requiring wound care and plastic surgery consultation.

The wound required well over 3 months to heal with a scar.

Discussion

Radiofrequency ablation has been proved to be safe and effective procedure in the management of tachyarrhythmias. Radiofrequency energy is a low voltage high frequency (30 KHz to 1.5 MHz) electrical energy. It was first tested safely in animal models to create AV nodal block by Huang et al.³ The ability of usage of catheter to deliver the RF energy coupled with the ability to create controlled focal tissue destruction resulted in increasing use of RF energy. Ability to use higher levels of RF energy in non-arrhythmic conditions such as in the management of tumours has led to identify new

Figure 1: Skin burn at the leading edge of the indifferent electrode pad over the abdominal pannus.



potential complication of the procedure.

Skin burns at the indifferent electrode have been identified and reported in electrosurgical procedures^{2, 4, 5} where the procedure typically lasts longer and requires higher energies. The electrical current passing through the body produces heat energy and increases the temperature of the tissues. According to Ohm's Law, the raise of temperature depends on the amount of electrical energy, density of the energy per attachment area, and the resistance to the flow of energy at then attachment site.

The biggest raise of temperature occurs at the tip of the catheter, where the electrical density is highest. This ability to raise the temperature which results in local tissue destruction makes the basic principle of ablation. Although similar amount of electrical current flows through the indifferent electrode, which completes the circuit, the temperature rise is much less because of the use of the dispersive pads. Dispersive pad reduces the electrical density by their size and wider area in contact with body and does not result in "exit wounds" as seen in electrical injuries. It was postulated that the temperature rise to 45-47°C at the indifferent electrode site can cause skin burn.⁶ The modern RF ablation catheters typically use higher energies. Faulty indifferent pads with cracks or loose connections may cause excess resistance in the circuit. Skin burn at indifferent electrode sites have described in the management of solid tumour ablations which typically require higher energies and long duration of energy application than a typical electrophysiology ablation.⁷

It is also known that the characteristics of the current flow towards a contact depend on the shape of the contact.⁸ The typical shape of the pad at the skin contact is acute or convex and the current density tends to be higher at such edges or sharp angles. It probably resulted in differential temperature raise at the pad contact site making the edges more vulnerable to burns. This might explain the 'leading edge phenomemon' described by Stenkie et al.⁷ Electrical conductive media such as normal saline or other body fluids which contain inorganic salts, when present at the pad site can change the path of circuit and may result in unwanted outcomes.

The rise in the temperature also depends on the ability of the human body to disperse the heat generated which in turn depends on the amount of blood flow, amount of the subdermal fat which acts as an insulator.⁷ When the surrounding room temperature is very low, it can result in vasoconstriction of cutaneous blood vessels further resulting in poor heat dissipation. The deep sedation of the patients during the procedure may result in ignoring the discomfort and pain caused by the raise in temperature.

We believe that, in this patient, multifactorial causes including obesity, excessive fat at the pad attachment site, deep sedation and environmental conditions resulted in the generation of excess heat at the pad site resulting in thermal injury.

Conclusions

Although rare, risk of skin burn at indifferent electrode site should be considered especially in obese patients undergoing RF catheter ablation. We believe that the poor blood circulation and excess fat at the site of pad attachment resulted in poor dissipation of heat resulting in the thermal burn in this patient. Using larger pads with wider area of contact, choosing a site with better cutaneous perfusion, rotation of the pads or using multiple ground pads with sequential activation, reducing the time of RF energy delivery, choosing less energy settings and avoiding deep sedation during the procedure may help in reducing such a complication.

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