Late Tamponade due to Rupture of Inferior Vena Cava-Right Atrial Free Wall Following Multiple Radiofrequency Ablations of Atrial Flutter

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Catheter radiofrequency ablation of atrial flutter is associated with a high procedural acute success rate and a low rate of acute complications. Cardiac tamponade is a very rare complication that almost always occurs early after the procedure. We present a case of late tamponade due to rupture of inferior vena cava-right atrial free wall in a 67 year old woman who underwent multiple radiofrequency ablations of atrial flutter.

PATIENT DESCRIPTION

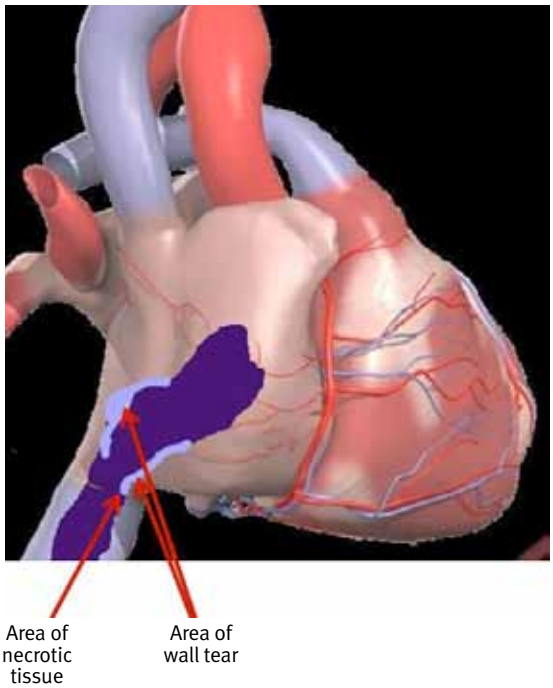
A 67 year old woman collapsed during swimming and was hospitalized in the Kaplan Medical Center. During the 3 years prior to hospitalization, she underwent several radiofrequency ablation procedures for recurrent atrial flutter (n=4) and atrial fibrillation (n=2) refractory to anti-arrhythmic therapy at the Tel Aviv Medical Center. The AFL ablation procedures were performed with various sized cooled tip ablation catheters, 4 mm and 8 mm. No steam pop was noted during any of the ablation procedures. The last procedure was performed 3 months before the present hospitalization and involved combined isolation of the four pulmonary veins and cavotricuspid isthmus ablation. Successful CTI ablation was achieved at the first radiofrequency line using an irrigated cooled tip catheter (Cordis™, Biosense Webster, Diamond Bar, CA, USA) at the very lateral CTI area ("08.00 o'clock" of the tricuspid annulus at a left anterior oblique view) after failure to affect CTI conduction using five radiofrequency lines delivered at the mid-part of the isthmus with a 8 mm tip ablation catheter (EPT™, Boston Scientific Corporation, Boston, MA, USA). At completion of the procedure the patient received 2 mg/kg of intravenous hydrocortisone followed by 0.5 mg/kg prednisolone per os/day for 3 consecutive days in an attempt to decrease the occurrence of early post-ablation atrial arrhythmias [1]. The patient was also treated with warfarin at therapeutic international normalized ratio levels.

The patient resumed her jogging activities 1 month after ablation (twice a week) and swimming activities 2 weeks prior to the present hospital admission. On that day, she was swimming for the second time after the last ablation when she suddenly felt severe chest pain with dyspnea before collapsing. On hospital admission marked hypotension (systolic blood pressure 50 mmHg), neck vein congestion and dyspnea were noted. An emergency chest computed tomography scan demonstrated a large amount of pericardial blood with severe cardiac tamponade and suspected active bleeding at the inferior vena cava area. Mechanical ventilation was established and inotropic medications were given. Pericardiocenthesis was performed, draining 200 ml blood with only minimal hemodynamic improvement. INR was 2.3 IU at this time. The patient was transferred to the operating room while hemodynamically unstable. Upon induction of anesthesia, electromechanical dissociation occurred prompting emergency sternotomy. The pericardium was found to be tense with blood. After initial drainage of approximately 1 L of fresh blood and large clots, free massive venous bleeding was observed to originate from the inferior vena cava. Upon inspection a large tear of the IVC and the right atrial free wall was observed. The mid-part edges of the tear at the IVC-RA junction appeared necrotic, suggesting this area as the initiation point of the cardiac rupture. An equine pericardial patch measuring 8 x 3 cm was used to close the tear with additional autologous pericardium reinforcing the lower edge at the diaphragm so as to prevent further tear into the abdominal IVC [Figure]. Following surgery the patient recovered fully. At the last follow-up 30 months after surgery the patient was asymptomatic on dronedarone therapy with only short-lasting episodes of AF documented on Holter recordings.

AFL = atrial flutter

CTI = cavotricuspid isthmus

INR = international normalized ratio
IVC = inferior vena cava
RA = right atrial



This illustration, drawn by the cardiac surgeon (Dr. Brauner), shows a large tear of the IVC and RA wall extending from the diaphragm to the IVC-RA junction, then over the RA anterior free wall, 1 cm anterior and to the right of the coronary sinus ostium, towards the tricuspid annulus. The mid-part edges of the tear at the IVC-RA junction seemed necrotic, suggesting this to be the initiation rupture site. A pericardial patch measuring 8 x 3 cm was used to close the tear, with additional autologous pericardium reinforcing the lower edge at the diaphragm in order to prevent further tear into the abdominal IVC

COMMENT

Atrial flutter is a common arrhythmia, and catheter ablation of the CTI is presently the most frequently performed procedure worldwide. A meta-analysis of clinical outcome after AFL catheter ablation in 10,719 patients (gathered from 158 studies) showed an 88–93% procedural acute success rate depending on the type of ablation catheter used [2]. The procedure is associated with a low rate of acute complications (2.6%) including pericardial effusion (0.1%), which occurs soon after the procedure [2].

Our patient presented with late cardiac tamponade after she underwent a redo procedure of ablation of AF and AFL. Delayed cardiac tamponade occurring after AF ablation is very rare, with a 0.2% incidence rate recently reported by Cappato at al. [3]. In our patient, the anatomic findings at surgery strongly suggest that the complication observed was a consequence of AFL ablation and not of AF ablation. To the best of our knowledge, our patient is the first reported case of late tamponade occurring after AFL ablation. Several unusual features were present:

- the patient underwent a total of four CTI ablation procedures before the definitive cure of AFL
- cardiac rupture occurred late (3 months) after the last ablation procedure
- cardiac rupture was located at the IVC-RA free wall junction, a location not previously reported as a site of cardiac rupture
- corticosteroid therapy was administered shortly after the last ablation procedure
- cardiac rupture was probably facilitated by excessive exercise.

The four procedures of AFL ablation in our patient were performed within a 2.5 year period. In the Tel Aviv Medical Center's 13 year experience with AFL ablation in approximately 1400 patients, this is the only patient who required four ablation procedures for curing AFL. We do not have any explanation why the CTI ablation was so hard to achieve in this patient. Multiple radiofrequency lines were administered during these procedures and probably resulted in extensive tissue damage. According to the anatomical site of the cardiac rupture, the last successful radiofrequency line delivered at the very lateral part of the CTI probaby played an important role in the late cardiac rupture. The multiple and extensive prior CTI ablation could also have contributed to the described complication.

The use of corticosteroid therapy shortly after AF ablation has been shown to decrease immediate and mid-term AF recurrences [1]. Our patient received intravenous hydrocortisone at the end of the procedure and oral cortisone after the procedure according to the protocol established in that study [1]. The potent anti-inflammatory effects of corticosteroids may preclude optimal healing of ablated tissues and could also have facilitated the late cardiac rupture [4].

A recent report of delayed fatal atrioesophageal fistula following AF ablation may be relevant to our case [5]. That complication was partially attributed to the fact that the patient received two short courses of corticosteroid therapy: one before ablation to perform CT angiogram (patient's history of contrast iodinated allergy) and the second after ablation to treat pericarditis.

Our patient returned to jogging activities 1 month after the last ablation procedure. However, she collapsed during swimming 3 months after the ablation. It is tempting to speculate that cardiac rupture was facilitated by exercise-induced mechanical tension over the atrial tissue already weakened by repeated ablation and corticosteroid therapy.

The use of warfarin could also have contributed to the extensiveness of bleeding, although the INR was within the therapeutic level (INR 2.3) at the patient's admission for cardiac tamponade.

The findings observed in our patient suggest the following clinical implications:

- Although the complication described in the present report is probably exceptional, one cannot exclude that it could have

AF = atrial fibrillation

been responsible for some late cases of cardiac mortality occurring after AFL ablation. The latter was reported in 1.8% of patients, including half of them with no demonstrable heart disease [2]

- During laborious CTI ablation procedures, one should consider limiting the number of radiofrequency lines administered, especially those in the very lateral part of the CTI and be resigned to declare failure of the procedure. In such patients, caution should prevail when using corticosteroids after ablation for any medical reason (such as pericarditis)
- In patients undergoing AF ablation, the use of prophylactic corticosteroid therapy to decrease AF recurrence should be carefully weighed if concomitant CTI ablation is performed during the ablation procedure
- After AFL ablation, a progressive return to normal sporting activities is usually allowed without special restriction a few days after the procedure. The findings in our case may suggest that in patients who have undergone repeated and laborious procedures and/or in those treated with corticosteroid therapy, clearance to resume sporting activities should be given very carefully.

In conclusion, our report demonstrates the possibility (albeit rare) of late tamponade after radiofrequency ablation of atrial flutter.

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Capsule

An ultraviolet-radiation-independent pathway to melanoma carcinogenesis in the red hair/fair skin background

People with pale skin, red hair, freckles and an inability to tan – the 'red hair/fair skin' phenotype – are at highest risk of developing melanoma, compared to all other pigmentation types. Genetically, this phenotype is frequently the product of inactivating polymorphisms in the melanocortin 1 receptor (*MC1R*) gene. *MC1R* encodes a cyclic AMP-stimulating G-protein-coupled receptor that controls pigment production. Minimal receptor activity, as in red hair/fair skin polymorphisms, produces the red/yellow pheomelanin pigment, whereas increasing *MC1R* activity stimulates the production of black/brown eumelanin. Pheomelanin has weak shielding capacity against ultraviolet radiation relative to eumelanin, and has been shown to amplify ultraviolet-A-induced reactive oxygen species. Several observations, however, complicate the assumption that melanoma risk is completely ultraviolet radiation dependent. For example, unlike non-melanoma skin cancers, melanoma is not restricted to sun-exposed skin and ultraviolet radiation signature mutations are infrequently oncogenic drivers. Although linkage of melanoma risk to ultraviolet radiation exposure is beyond doubt, ultraviolet-radiation-independent events are likely to have a significant role. Mitra et al. have introduced a conditional, melanocyte-targeted allele of the most common melanoma oncoprotein, BRAFV600E, into mice carrying an inactivating mutation in the *MC1R* gene (these mice have a phenotype analogous to red hair/fair skin humans). The authors observed a high incidence of invasive melanomas without providing additional gene aberrations or ultraviolet radiation exposure. To investigate the mechanism of ultraviolet radiation-independent carcinogenesis, they introduced an albino allele, which ablates all pigment production on the Mc1re/e background. Selective absence of pheomelanin synthesis was protective against melanoma development. In addition, normal Mc1re/e mouse skin was found to have significantly greater oxidative DNA and lipid damage than albino-Mc1re/e mouse skin. These data suggest that the pheomelanin pigment pathway produces ultraviolet radiation-independent carcinogenic contributions to melanomagenesis by a mechanism of oxidative damage. Although protection from ultraviolet radiation remains important, additional strategies may be required for optimal melanoma prevention.

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"Most people think that shadows follow, precede, or surround beings or objects. The truth is that they also surround words, ideas, desires, deeds, impulses and memories"

Elie Wiesel (b. 1928), Romanian-born Jewish-American writer, professor, political activist, Nobel laureate, and Holocaust survivor