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## Editorial on “*Diagnosis and treatment of cardiac tamponade during radiofrequency catheter ablation for arrhythmias*”

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Radiofrequency-based catheter ablation (RFCA) is a well-established therapeutic approach for a wide variety of arrhythmias. Over the years, complexity of catheter-based ablation procedures has progressively increased due to the inclusion of patients with more complex substrates and multiple comorbidities. The latter increases the possibility of serious adverse events, especially in the elderly.<sup>1, 2</sup> Many of the current electrophysiological substrates undergoing catheter ablation also require a transseptal puncture to achieve the left cardiac chambers, which increases complexity. One of the most serious complications during complex ablation substrates as atrial fibrillation (AF) and ventricular arrhythmia (VA) is cardiac tamponade, a life-threatening complication that represents the research topic of the recent study by Songqun Huang *et al.*, published in *Xiangya Medicine*.<sup>3</sup> The authors report their experience after more of 6,000 RFCA procedures performed during the last two decades in one center. The article describes the incidence of tamponade in different ablation substrates, along with the clinical diagnosis, treatment and prognosis.

As expected, the number of RFCA procedures in patients with AF and VA gradually increased over the last two decades. From the beginning of the series, in the mid 90s, until the last year of inclusion, the number of procedures quadrupled, which correlates with the current global trend. The highest incidence of cardiac tamponade was reported during AF ablation (0.76%). However, this incidence is still lower than the data reported by Cappato *et al.* in a worldwide survey,<sup>4</sup> or more recent data from a large series of in-hospital complications associated with AF ablation in the United States, in which pericardial complications over a 10-year period (from 2000 to 2010) were reported as 1.5%.<sup>1</sup> A common factor reported in all series is the relationship between early stages of the learning curve and a higher incidence of complications. In fact, cardiac tamponade in high volume centers performing AF ablation may be as low as 0.25% as reported by Aldhoon *et al.* in 1,192 consecutive AF ablation procedures with routine use of intracardiac echocardiography.<sup>5</sup> Moreover, both hospital annual procedure volume and annual operator volume are independent predictors of complications in AF ablation procedures,<sup>1</sup> which correlates with a higher incidence of cardiac tamponade reported by Songqun Huang *et al.* during the learning curve of two new operators performing VA substrates.<sup>3</sup>

The risk of cardiac perforation in patients undergoing VA procedures could be expected to be lower due to thicker myocardial walls in the ventricles than in the atria. However, these differences in myocardial wall thickness are less pronounced in the right ventricle, which makes the right ventricular chamber especially sensitive to severe cardiac perforation requiring surgical repair. In fact, Songqun Huang *et al.* report that 50% (3 out of 6) of patients with cardiac tamponade during ablation of premature ventricular complexes required surgical repair to control the pericardial effusion. However, the overall rate of cardiac tamponade reported by Songqun Huang *et al.* during ablation of VA (0.57%) is still lower than a 1% incidence reported by other authors as Tokuda *et al.*<sup>6</sup> who published their experience after 1,152 RFCA procedures in patients undergoing ablation of different VA substrates from a tertiary referral center over a 11-year period.

Regarding cardiac tamponade during ablation procedures in supraventricular arrhythmias, Songqun Huang *et al.* reported a 0.13% incidence of cardiac tamponade, which is also lower than the incidence (0.6%) reported from a large series of 1,050 patients by the Atakr Multicenter Investigators group.<sup>7</sup>

This Chinese group also reported gender related-differences in cardiac tamponade. Thus, females accounted for up to 81% among the tamponade cases, which was significantly higher than in males. Michowitz *et al.* also showed that women may have an almost 2-fold higher risk for developing this complication in a worldwide survey of more than 34,000 patients undergoing AF ablation.<sup>8</sup> In this large series, women tended to develop more tamponades during transseptal catheterization. A higher incidence of atrial septal aneurysm among women may render transseptal puncture more difficult. Moreover, it is well known that women have thinner left atrial wall and lower atrial volume, which may also explain that most cases of tamponade occurred during catheter manipulation or ablation.<sup>8</sup> Controversial data in this issue must be take with caution, because the studies that have not proven a link between sex and risk of tamponade were underpowered to estimate a direct association.<sup>9, 10</sup>

Differences in the data reported by different series may be related to factors as heterogeneity in the interventional approach,<sup>5, 11, 12</sup> complexity of the substrates undergoing catheter ablation,<sup>13, 14</sup> and the learning curve of the operators performing the procedures.<sup>1, 15</sup> The latter has been proven to be a key factor in the complications rate of patients undergoing catheter-based ablation.<sup>1, 2</sup> In fact, a single center experience with expert operators decreases the probability of complications compared with complications reported in worldwide surveys,<sup>5</sup> in which the inclusion of lower volume centers will be associated with a higher risk of complications.<sup>1</sup> Differences between this Chinese work by Songqun Huang *et al.* and larger series may also be related to selection bias to report complications, as well as limitations about data collection on the database, which are usually difficult to identify in the manuscripts.

Despite an overall lower incidence of cardiac tamponade in this Chinese series compared with other large series, which may be explained by data from a high volume center and expert operators, certain details about specific aspects of the procedures are missed. Thus, the use of open-irrigated tip catheters in the right ventricular outflow tract may explain some cases of severe cardiac tamponade, especially in the absence of contact-force monitoring by some of the current ablation catheters. Routine use of intracardiac echocardiography to monitor different steps of the procedure may also explain a higher incidence of complications in the initial stages of the learning curve.<sup>12</sup> Hence, a more detailed description of the procedures would be desirable (e.g. anticoagulation use in the periprocedural time).

Clinical signs of hemodynamic deterioration like tachycardia and hypotension were the first clinical manifestation of tamponade. This observation highlights the need for a rigorous clinic and hemodynamic monitoring during RFCA procedures. In fact, Nanthakumar *et al.* carried out an elegant experimental study in pigs undergoing intrapericardial saline infusion until the pericardial pressure equalized with right ventricular end diastolic pressure or the systolic blood pressure reached 40 mm. Hg.<sup>16</sup> They observed an early reduction in cardiac silhouette excursion, even before hemodynamic collapse. Accordingly, diagnosis of tamponade is made in the basis of clinical manifestations plus X-ray and echocardiography findings. All the patients in the series by Huang *et al.* fulfilled the criteria for the diagnosis of cardiac tamponade and treatment efforts were oriented to drain the pericardial fluid (81% without need of surgery). Favorable prognosis upon appropriate treatment has been consistently reported by other authors, although 1% of cases of cardiac tamponade might culminate in death, despite surgery, as reported by Michowitz *et al.* in a worldwide survey of 34,943 patients undergoing AF ablation. Despite the study by Huang *et al.* did not report any death related to cardiac tamponade, it highlights the need for early diagnosis and treatment.

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