You get what you inspect, not what you expect: can we make the transseptal puncture safer?

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Received 16 August 2010; accepted after revision 6 September 2010

This editorial refers to ‘Transseptal puncture using minimally invasive echocardiography during atrial fibrillation ablation’ by L. Mitchell-Heggs et al., on page 1435

Progress in the field of catheter ablation for atrial fibrillation has resulted in a renaissance of the technique of transseptal (TS) catheterization. Conventionally, the procedure is performed under fluoroscopic guidance and pressure monitoring. In experienced hands, various modifications of this method have a reasonable safety profile. However, serious complications such as cardiac tamponade (1.31%) or aortic perforation can still occur and can lead to death (0.15%). Even in a more recent, large Italian survey on 5520 TS procedures performed between 1992 and 2003 at 33 centres, some severe complications were reported. Although the complication rate was low (0.79% in 2003 and 0.74% in the previous years), one death was described. To reduce the incidence of such complications, TS puncture can be done under transoesophageal echocardiography (TEE) or intracardiac echocardiography (ICE) guidance. Transoesophageal echocardiography in these settings necessitates a higher level of sedation and is often poorly tolerated. Intracardiac echocardiography requires an additional expertise and significantly increases the cost of the procedure.

Mitchell-Heggs et al. describe an alternative TEE technique to guide the TS puncture during atrial fibrillation ablation procedures using an ICE catheter introduced transnasally into the oesophagus. This technique was well tolerated and successfully performed in all 79 successive patients without any sedation. Insertion of the catheter was without any mechanical complication and TS puncture was successful and uneventful. The mean duration between the probe insertion and successful TS puncture was 4.5 min and the mean time of ICE in the oesophagus was only 10 min. The authors have concluded that the technique is safe and well tolerated. They recommend it for widespread use, especially due to its good value for money. At first sight, this report may not be so appealing for the electrophysiology community. However, it is an important online imaging strategy which can be used during complex interventions to maximize safety and efficacy.

The use of echocardiographic guidance for TS puncture allows direct visualization of the tip of the TS needle within the fossa ovalis and thus, a safe TS puncture in every patient. In this respect, there seems to be no difference between the TEE and ICE approach. Our retrospective analysis of 1692 TS punctures guided by ICE between 2006 and 2009 revealed no complications associated with the puncture (unpublished data). This provides indirect evidence that the use of online imaging may increase the safety of the procedure, especially in anatomical variants of the intraatrial septum that make the procedure challenging (e.g. lipomatous hypertrophy, septal aneurysm, thick septum, or double membrane fossa, etc.).

The safety of the echocardiographically guided TS puncture supports the use of a double TS access to prevent interference between the mapping and ablation catheters and to achieve greater mobility and manoeuvrability in the left atrium. It is also important to emphasize that the use of echocardiographic guidance enables selection of the site of the puncture within the fossa ovalis according to the expected type of the procedure (e.g. more anterior puncture for ablation of an accessory pathway at the mitral annulus or for ablation of ventricular tachycardia vs. a lower and more posterior puncture for ablation of atrial fibrillation). Although it is difficult to quantify the benefit of such a selective TS puncture, our experience has shown that even <1 cm difference in the location of the puncture site can make a significant difference in manoeuvrability of the mapping and/or ablation catheter (Figure 1). This seems to be even more important when using ‘one-size-fits-all’ devices such as a cryoballoon or laser balloon. Today, we use an ICE-guided TS puncture even in cases of a patent foramen ovale since it allows us to optimize puncture in the lower and more posterior portion of the fossa ovalis. A group from Bordeaux has clearly documented that isolation of the pulmonary veins performed via a patent foramen ovale is more difficult, both for the left- and right-sided pulmonary veins. Very superior and anterior location of the foramen ovale changes the radial movement of the catheter entering the left atrium and impedes the manipulation around the pulmonary veins. This results in less accurate positioning of the catheter and its greater instability. Although the authors did not

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observe any difference in acute or mid-term success of the procedure, the intervention turned to be significantly longer. At least theoretically, this may also result in a lower long-term success rate because of a more frequent recovery of conduction to the pulmonary veins.

One of the usually neglected advantages of echocardiographic guidance during the TS puncture is the possibility of initiating anticoagulation safely before the TS puncture. This appears to be a very important additional benefit, especially in patients with atrial fibrillation. Under such circumstances, the risk of thrombus formation is high, despite anticoagulation to activated clotting time (ACT) $>250\,\text{s}$. In this respect, left atrial thrombus formation has been detected in over $10\%$ of left atrial catheter ablation procedures, especially in subjects with documented spontaneous echo-contrast. Although there is little published evidence on the impact of early heparinization on decreasing ICE-detected thrombus formation and/or on thrombo-embolic complications, few studies are available. Thus, in one study, the incidence of thrombosis was significantly lower when heparin was given before the first or second TS puncture compared with heparin administration after the TS puncture ($3.1\%$ vs. $9\%, P < 0.001$). A thrombus was detected on a mapping or ablation catheter in 16 out of 29 patients, and in the remaining 13, it was present in the left atrium or appendage. More importantly, a thrombus was safely removed by aspiration through the sheath in 21 out of 29 cases. These observations are in line with our experience with an ICE-guided TS puncture. In the early learning phase, we did not administer heparin before the puncture and probably therefore observed a rapid thrombus formation on the sheath immediately after the puncture (Figure 2). In recent years, using a strategy of early heparinization before TS puncture, we have seen no thrombus on the sheath. The use of ICE also contributed to the change in the intensity of anticoagulation during the catheter ablation procedure for atrial fibrillation. An increased intensity of heparin anticoagulation ($\text{ACT} > 300\,\text{s}$) appears to prevent thrombus formation more efficiently compared with $\text{ACT} 250–300\,\text{s}$.9

It has to be emphasized that the use of echocardiographic monitoring during the entire atrial fibrillation ablation procedure allows for additional benefit beyond safe TS puncture. This may be easily accomplished by ICE. However, transnasal insertion of an ICE catheter into the oesophagus as described may also be employed. Echocardiographic monitoring throughout the ablation procedure may help to understand the real-time anatomy of relevant cardiac structures such as the pulmonary veins, left atrial appendage, mitral isthmus, cavotricuspid isthmus, etc. The assessment of the position of the tip of the ablation catheter and its contact with the tissue is another advantage of online echocardiography. When using a non-irrigated tip, echocardiography can be employed to monitor microbubble formation and thus, imminent tissue overheating.

This imaging modality also supports image integration since it allows online registration of three-dimensional computed tomography and magnetic resonance imaging (MRI) reconstructions. In some cases, ablation lesions or oedema of the tissue can be visualized. However, one of the most important advantages of the intraprocedural use of echocardiography is prevention and/or early detection of complications. Echocardiographic monitoring allows visualization of the ostia of the pulmonary veins or the oesophagus and/or assessment of intracardiac thrombi. Last but not the least, early detection of pericardial effusion and/or tamponade may prompt immediate treatment.

In conclusion, the echocardiographic technique described represents another strategy to guide the TS puncture and increase the safety of this procedure. In addition, it has a potential to be employed for continuous monitoring of the atrial fibrillation ablation procedure. The safety slogan ‘you get what you inspect, not what you expect’ is also true in advanced electrophysiology.

**Conflict of interest:** J.K. is a member of the advisory board and speaker’s bureau for Biosense Webster, GE Healthcare, and St Jude Medical (manufacturers of different ICE catheters).
References


