ATRIAL FIBRILLATION

Editorial

Internal cardioversion. Is it needed? How best to perform it

Restoration of sinus rhythm is indicated in a number of patients with non-self-terminating atrial fibrillation (AF). It can be achieved either by using antiarrhythmic agents, so-called ‘pharmacological cardioversion’, or electrically using transthoracic cardioversion.

Pharmacological cardioversion is an appealing technique as it does not always require hospitalization, at least in most European countries. However, it is only associated with a high success rate if AF has been present for less than 1 week and, at most, less than 1 month[1–3]. In addition, it should be remembered that the rules of anticoagulation also apply to pharmacological cardioversion required whenever AF is longer than 48 h. This makes the technique impractical and unsafe[4]. Other options are to treat the patient for 3 weeks with warfarin before attempting cardioversion, which lowers the success rates, or to undertake a transesophageal echocardiogram under heparin therapy to rule out intra-cardiac thrombi. Furthermore, the safety of the antiarrhythmic agent to be used should be tested in hospital before applying this technique out of hospital.

The technique of choice for cardioversion of AF is external transthoracic cardioversion. The technique has been shown to be safe and to be associated with success rates ranging from 65 to 90%[5,6]. Among the determinants of immediate success rates, duration of AF is the factor found most often in various studies[7,8]. The benefits of sinus rhythm are acknowledged by the medical community despite the lack of evidence showing that it is superior to slowing the heart rate. It is, therefore, likely that the indications for cardioversion will be extended not only to patients with AF established for 1 or more years, but also to patients with an enlarged left atrium and those who failed previous attempts to restore sinus rhythm with pharmacological or conventional external cardioversion. This explains the attempts to increase the success rates of external cardioversion using very high (>400 J) energy cardioversion, or defibrillators with biphasic waveforms which are supposed to defibrillate the heart with less energy. So, where does internal cardioversion stand? Internal cardioversion was proposed as a technique using high energy (200 or 300 J) applied through a catheter (regular quadripolar USCI, Bard), placed in the tricuspid area, and an external patch; the distal electrode of the catheter being the cathode and the patch being the anode[9]. This technique was shown to be superior to external cardioversion in a randomized study with no more recurrences over long-term follow-up, and was proposed as a therapeutic option in patients who failed both pharmacological and external cardioversion[6].

The experimental work of Cooper et al.[10] in sheep, studying various electrode configurations and shock waveforms, showed that the lowest atrial defibrillation threshold was achieved when biphasic waveform shocks were applied through large surface electrode catheters placed in the right atrium and the coronary sinus. A multicentre study in man[11] and studies from a number of centres throughout the world[12–14] have shown that it is possible successfully to cardiovert 85% or more patients with non-self-terminating episodes of paroxysmal AF, and 75% or more patients with established AF with energy levels of ≤6 J. Using higher energies (up to 20 J), success rates of 100% were reported[13]. Alt et al.[12] suggested that the left pulmonary artery could be an alternative to the coronary sinus when the latter cannot be catheterized. Their work was the basis for the development of a single catheter with two large surface electrodes; one to be placed in the right atrium and the other in the left pulmonary artery[16]. The catheter has electrodes which detect the right ventricle and, when needed, pace the right ventricle following post shock pause. Techniques using low-energy internal cardioversion with either two catheters or a single catheter have been shown to be safe, providing
proper R wave synchronization and delivery of shocks following RR intervals >500 ms\(^{[17]}\). No proarhythmia was observed if these two safety measures were respected. Experience with the stand-alone atrioverter which contains these two features confirms the safety of internal low-energy cardioversion.

The possibility of converting AF to sinus rhythm with low energy allows one to avoid general anaesthesia which may be hazardous in very sick patients with AF. The shocks are only performed under mild sedation with midazolam (0.05 mg/kg bodyweight). Low-energy cardioversion has also recently been shown to be successful and safe in patients with a history of heart failure and depressed left ventricular function. In such patients, external cardioversion may present the risk of inducing pulmonary oedema; a known complication of external cardioversion attributed to atrial stunning. There are other selective indications of low-energy internal cardioversion, such as obese patients with high thoracic impedance as the bodyweight has been found to be a determinant of failure of external cardioversion\(^{[6]}\), and patients with pulmonary diseases such as emphysema or asthma which also increase thoracic impedance. Patients with an enlarged left atrium (>55 mm at transthoracic echocardiogram) have been found to be successfully cardioverted with low-energy cardioversion\(^{[16]}\).

The reports of Schmitt et al.\(^{[18]}\) and Taramasco et al.\(^{[19]}\) have shown success rates of 75% or more with low-energy internal cardioversion in patients who failed external cardioversion. This is of no surprise since Alt et al.\(^{[16]}\) showed, in a randomized study comparing external to low-energy internal cardioversion, that the success rates were significantly higher with internal cardioversion. The study of Andraghetti and Scalese in the previous issue of Europace\(^{[20]}\) on a large number of patients (367 patients) and an even larger number of procedures (n=500) confirms that low-energy internal cardioversion is efficient and safe in patients with persistent AF. It is interesting to note that 57% of their patients had failed previous attempts at external cardioversion. Furthermore, their study showed that a single catheter with two coils did as well as two single-coil catheters, suggesting that the technique of low-energy cardioversion can still be improved.

Although external cardioversion is a non-invasive and safe technique, it does require general anaesthesia and, in some countries such as France, the effective presence of an anaesthesiologist in the room, which is not always possible. This results in a longer stay in hospital for those patients admitted for AF, or admitted for another reason and found to have persistent AF. Internal low-energy cardioversion in these patients shortens the hospitalization period. This is an indication of internal low-energy cardioversion which makes this technique cost-effective in this setting.

Atrial fibrillation may complicate electrophysiological studies or ablation procedures requiring external cardioversion, or the interruption and repetition of the procedure which is costly and uncomfortable for the patient. Low-energy internal cardioversion is useful in this setting as it allows one to pursue the procedure. Recently, focal ablation of the pulmonary veins has been proposed as a therapeutic option and is undergoing intensive evaluation in a number of centres\(^{[21]}\). This procedure may be complicated by persistent AF which does not allow appropriate mapping. Low-energy cardioversion allows restoration of sinus rhythm at will.

Therefore, whereas external cardioversion remains the technique of choice for restoring sinus rhythm in most patients, in order to enjoy the benefits of sinus rhythm, internal cardioversion has selected indications, e.g. patients who are likely to fail external cardioversion such as obese patients, or patients with bronchopulmonary diseases or those who already failed external cardioversion. It will also be an option for those patients in whom general anaesthesia may present a risk or is not available. It is also the technique of choice to stop AF complicating electrophysiological studies or ablation procedures.

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References


