Epicardial Hifu Ablation – A Stand Alone Possibility ?

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For a surgical approach to the treatment of stand alone AF to be widely adopted it will have to fulfil certain requirements:-

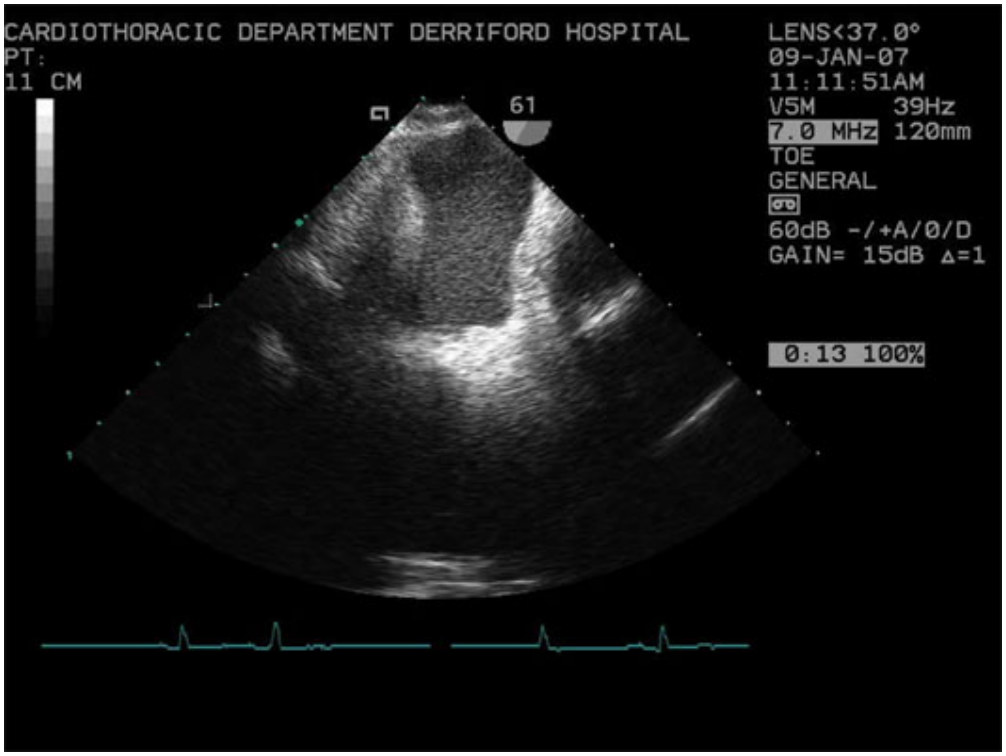
- Ability to be used epicardially without requiring cardiopulmonary bypass
- Proven efficacy
- Associated with minimal complications
- Deliverable through small incisions

Epicardially use without requiring cardiopulmonary bypass

HIFU is designed to be used epicardially on the beating full heart.

The ultrasound causes tissue damage through two predominant mechanisms, conversion of mechanical energy into heat and cavitation. The pulsed HIFU relies on the fact that above a threshold of 56° C (for 1 sec) rapid thermal toxicity occurs, causing irreversible cell death through coagulative necrosis. The beam carries sufficient energy within a focal volume to cause a local rapid rise in temperature and cause tissue necrosis with no damage to surrounding or over/underlying tissue. Alterations in the mode of delivery (pulsed or continuous), frequency, power and the duration of the ultrasound create injury at different depths of the myocardium resulting in transmurality.

The ultrasound is delivered using two devices. The first is the *cinch* device which encircles the pulmonary veins and the posterior left atrium. It narrows the left atrium as the pulmonary veins enter the cavity and fluid irrigation ensures continual contact with the beating heart. The device is constructed in such a way that it has to form a complete encircling loop and thus no gaps are left as the heart moves. A TOE illustrating the cinch in situ prior to ablating is shown below.



The hand held *wand* is used to complete the mitral isthmus line epicardially, again with continual irrigation to ensure contact with the beating heart.

Efficacy and complications

The use of HIFU was first described in 1942 (1) and the first clinical paper was in 1958 (2). It has several therapeutic uses and has been used in over 3000 cases worldwide for myocardial ablation with no adverse events reported.

The data concerning the efficacy of HIFU ablation is from concomitant AF patients only (3). In a population of predominantly permanent AF (74%) with mean left atrial diameter of 5.15 cm the freedom from AF at six months following ablation was 85% (80% for permanent AF and 100% for paroxysmal AF)(3).

Access and incisions

HIFU has predominantly been delivered through a median sternotomy as an adjunct to other cardiac surgical procedures. There is however some experience with both the *cinch* and hand held *wand* via a small right thoracotomy. The access is via a 5cm incision in the fifth intercostal space.

The pericardium is opened anterior to the phrenic nerve and cinch inserted. The *wand* can also be used to ablate through this incision. The video below shows such a procedure (courtesy of Dr M Groh, Asheville, USA)

There is very limited experience with mini-sternotomy for using the *cinch* alone.

Conclusion

HIFU is proven technology for treating concomitant AF. It offers a suitable platform to fulfil the criteria for use as a stand alone technique but its efficacy needs to be proved in this population.

References

1. Lynn et al. J Gen Physiol 1942;26:179-93
2. Fry et al. Am J Phys Med 1958;37:152-6
3. Ninet et al. JTCVS 2005;3:803-9