How to do it
The de-airing clamp in cardiac surgery

Mogens Bugge*, Vincenzo Lepore, Annica Dahlin

The Department of Cardiovascular Surgery, Sahlgrenska Hospital, Gothenburg University, 413 45 Gothenburg, Sweden

Received 17 October 1995; revised 14 February 1996; accepted 20 March 1996

Abstract

De-airing of the heart in open heart surgery is a necessary routine. Most of the air is evacuated from the heart before the aortic cross clamp is removed, but the de-airing may be continued even after declamping. One way to continue de-airing is to partially clamp the ascending aorta, proximally to the aortic cannula, in order to create a pocket for trapping residual air coming from the left ventricle. This paper describes a clamp specially designed and developed for this purpose. It has been used in our center since 1990 and our experience is reported. The clamp has been used on 250 patients and in 50% ultrasonography has been used to examine the heart being free from air bubbles within 20 min from releasing the aortic cross clamp. Copyright © 1997 Elsevier Science B.V.

Keywords: Aortic valve replacement; Air embolism; De-airing of the heart; Aortic clamp

1. Material and methods

The design of the clamp is shown in Fig. 1. It is a modified standard aortic cross clamp where one of the legs is bent to form a hook and the other is shortened and smoothly bent out. All edges are rounded and the branches are 6 mm wide and flat-bladed. The original shark-teeth of the jaws are partly kept to hold the clamp in place but in the tips of both clamp-legs the teeth are taken away to make the clamp as atraumatic as possible. The precision of the performance of the clamp is not critical since it is not constructed to close the aorta but only for the above mentioned purpose.

When applied over the aorta, a standardized opening of approximately 15 mm is formed as shown in Fig. 2.

* Corresponding author.
Fig. 2. The de-airing procedure with the clamp in position. Please note the blood flow in retrograde direction beneath the clamp which is positioned between the aortic vent and the aortic cannula near to the highest point of the ascending aorta. (The clamp is produced by: Pilling USA, 420 Delaware Drive, Fort Washington, Pennsylvania, 19034 USA. Tel.: +1 215 6432600; fax: +1 215 6437930. Reference number for the clamp: 60–4500).

The aorta is in cross section shaped to a rain-drop form with as little tension in the wall as possible caused by the deformation of the aorta.

2. Discussion

To form a pocket in the aorta for trapping air by a partial clamp is a well described procedure [1]. What is new with this clamp is the shape of the instrument which results in a more atraumatic distortion of the aortic wall than a standard clamp achieves. This is especially important if the aortic wall is weak, thin or dilated or in case of a sudden rise in blood pressure. A standard clamp may in those situations cause a perforation or initiate a dissection of the aortic wall. Both events are unacceptable complications to the de-airing procedure. The clamp gives a standardized opening of the aorta which allows blood to flow retrogradely through the ascending aorta to the vent and to the coronary arteries. A jet of blood through the lumen under the clamp is created and it is in fact this jet which is the reason for ejected air being inhibited from passing the clamp and instead directed to the vent. With ecocardiography intracardiac air bubbles are easily visualized and the heart should not be allowed to eject vigorously before all air bubbles are removed. Without a partial clamp ejected blood will pass the ascending aorta in 0.1–0.2 s. To hope that air bubbles contained in the ejected blood should separate from the blood and leave the aorta through a simple venting needle in such a short time seems to us rather optimistic. Thus, the air sometimes observed leaving the aortic root vent is to our opinion probably only a minor fraction of the air passing the aorta.

In conclusion, we have found this clamp an interesting tool which in its simplicity adds an extra dimension to the standard de-airing procedure. We have seen no drawbacks with this instrument and we have not noticed any damage to the aorta caused by the instrument.

3. Summary

A clamp, specially developed for use during the de-airing phase of open heart surgery is presented and discussed after having been in use for 4 years on 250 patients. Its function is characterized by the creation of a pocket in the ascending aorta for trapping air. The clamp was found less traumatic and more safe than a standard clamp used as a partial clamp across the aorta as used by many surgeons.

References