The Heart Surgery

EDITORIAL

The TRUCAB, the "H" Graft, and the Steal Syndrome

(#1999-18587 … November 14, 1999)

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Definition of TRUCAB and "H" Graft

The truly minimally invasive coronary artery bypass (TRUCAB) procedure is basically a palliative procedure for sick patients with a high Parsonnet score [Parsonnet 1989]. In this operation, the mammary artery is left undissected in its bed, and a graft of radial artery or sometimes saphenous vein is brought from the mammary artery to the left anterior descending (LAD). The key point is that the distal internal mammary artery (IMA) is clipped to prevent steal [Coulson 1998a, Karamanoukian 1999]. In the "H"-graft technique, the internal mammary is similarly left in situ, but it is not clipped or oversewn distally. A graft of right inferior epigastric artery is sutured to the IMA and then to the LAD. On angiographic study, the parallel LAD and internal mammary with the graft as a crosslink have an "H" appearance. This technique was first described by Calafiore et al. [Calafiore 1996a] and popularized by Cohn et al. [Cohn 1998a].

Origins of the TRUCAB

The suggestion has been made that the TRUCAB concept was somehow based on the "H" graft [Wolf 1998]. This is not true. The TRUCAB was developed entirely independently and, in fact, preceded the "H" graft concept by about a year.

When minimally invasive direct coronary artery bypass (MIDCAB) surgery first started at Dameron Hospital (January 1996), we did not have the special rib retractors necessary to mobilize the whole length of the IMA, and quite often the IMA simply would not reach the target LAD. We resorted to the use of radial artery (RA) grafts and saphenous vein grafts to extend the IMA. In some cases it was immediately obvious that the IMA would never reach the LAD target because of cardiomegaly or extreme clockwise rotation of the heart so it seemed pointless to even start dissecting it. In such cases, the left internal mammary artery (LIMA) was simply divided and sutured end-to-end to a graft extension going to the LAD, as shown in Figure 22 of our description of the technique [Coulson 1997a]. It was subsequently realized that a technical advantage could be achieved by leaving the IMA undivided in its location and making an end-to-side anastomosis. This also made it possible to take big bites of the tissues surrounding the IMA and thus minimize the risk of stenosis at this anastomotic site. At that time, we were not aware of Calafiore's work.

In the eight-month period from January to August 1996, extension grafts or TRUCAB techniques were used in 45 patients at Dameron Hospital. Their patency rate is 87.5% at three years using ultrasound studies, angiography, or clinical assessment. The first time the mammary artery was left entirely in situ, and not dissected in any way, was on January 18, 1996. This patient was restudied in October 1998. The saphenous vein conduit had some areas of low-grade stenosis on the angiogram, but it was still patent, and the IMA was clearly seen not to be mobilized in any way. Dr. Cohn was kind enough to show this picture in his talk in Cincinnati in 1998 [Cohn 1998b].

This first phase of our TRUCAB experience (the use of extension grafts) was written up in September 1996; the manuscript was circulated widely in late 1996 and was even sent for consideration for publication to Heart Surgery Forum in October 1996. Subsequently, the technique was published in April 1997 on the Dameron Hospital Heart Institute home page: http://www.home.inreach.com/dmrn_hrt [Coulson 1997a] (see Movie 1 ◎). The significance of this paper lies in the first sentence of the abstract: "This paper is a detailed practical account of our technique for MIDCAB bypass surgery using the radial artery to extend the internal mammary artery to avoid trauma to the chest wall." Figures in the paper illustrate suturing of the radial artery to the LAD and subsequent suturing of the radial artery to the IMA. In Figure 20, it is obvious how close we were to the sternum when the suturing was done.

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It must be stressed that it never occurred to us that there would ever be a reason to leave the distal IMA patent; this seemed to us to be the biggest potential source of steal from the IMA or the coronary artery. However, it did strike us that the TRUCAB technique and the use of extension grafts was a much simpler and quicker way of doing MIDCAB surgery. It appeared to be a truly minimally invasive technique because it avoided chest wall retraction and possible trauma to the IMA during harvesting. In this regard, the descriptor, "truly minimally invasive," was used in an article written in early 1997 and published in the AORN Journal [Coulson 1997b]. However, we maintain that the direct LIMA-to-LAD anastomosis is the gold-standard surgery and that the use of extension grafts is a second-class operation.

Calafiore's Papers

Based on his work on composite arterial conduits, Calafiore reported that on thirteen occasions he had used the inferior epigastric artery to extend the IMA; on one occasion he used the epigastric as a side branch of the in situ LIMA to reach the LAD. On other occasions, the epigastric artery was used to extend the LIMA in an end-to-end fashion or as a side branch of a LIMA-to-LAD graft to reach an important diagonal branch [Calafiore 1996a, Calafiore 1996b].

Cohn's "H" Graft

In their paper, Cohn et al. also described the use of an inferior epigastric artery sutured as a side branch to the in situ IMA and brought over to the LAD in the form of an "H" [Cohn 1998a]. The indication for this procedure, as reported in their paper, was a high incidence of technical problems during routine MIDCAB surgery (33% angiographic abnormalities). In the same paper, they reported that the technique was used on three sick patients who were prohibitively poor candidates for conventional coronary artery bypass with cardiopulmonary bypass. But the main attraction of the technique was that the IMA was preserved for future coronary revascularization (hence, the lack of distal clipping). It was not specifically aimed at high-risk patients, but it was, in their opinion, "the grafting procedure of choice" for all MIDCAB patients.

TRUCAB as Palliative Procedure for High-Risk Patients

An increasing number of high-risk patients (high Parsonnet scores) were referred to us in 1997. They needed minimal anesthesia, swift surgery, and as little chest-wall trauma as possible to reduce postoperative pain and morbidity. In these patients, we planned from the onset to use the TRUCAB technique and not even attempt a MIDCAB procedure.

Since we planned on publishing the TRUCAB approach specifically for high-risk patients, we thought it was important to document pressure and flows. We had noted on the angiograms of the earlier patients that there was a tendency towards stenosis at the end-to-end RA-IMA anastomosis. This consideration was the driving force to stress the need for interrupted sutures and for not disturbing the IMA so that the soft tissues around the IMA could be used to buttress the sutures and hold the IMA patent. In all cases, the distal IMA was clipped as this was considered the most threatening source of steal (see Movie 1 ◉). Our view has now been proven correct by an elegant study of steal during "H" grafting by Karamanoukian [Karamanoukian 1999]. We felt the patients were not getting the gold-standard LIMA-to-LAD direct, but they were getting a palliative procedure. We thought this decision was justifiable in view of the high-risk nature of the patients. Thus, a change in thinking had occurred. The technique was no longer for the surgeon's benefit to avoid difficult IMA dissection but for the patient's benefit to minimize the surgical trauma [Coulson 1998a, Coulson 1998b]. The patency rate has proved to be 91% at three years.

Comparison of the TRUCAB and "H" Graft

Both techniques are superficially similar insofar as the IMA is left in situ, but the indications for doing this are different. In the "H"-graft technique, the motivation is to preserve the whole length of the IMA for future revascularization. By way of contrast, in the TRUCAB technique, the IMA is left in situ for a simple practical reason: it is possible to use the surrounding tissue to buttress the anastomosis and reduce the risk of stenosis. However, the truly important difference between the TRUCAB and the "H" graft is that in the "H"-graft arrangement, the distal IMA is left patent so that hemodynamically the graft is effectively an extended side-to-side anastomosis between the LIMA and LAD. We regret to say that we feel this is the weak link of the "H" arrangement, and the significance of the steal paper by Karamanoukian et al. confirms our impression [Karamanoukian 1999].

We can also corroborate some of Karamanoukian's other findings. In four cases we have measured flows before and after clipping the distal IMA. In each case the flow in the radial artery conduit was increased after clipping. (These findings have not been published yet.)

An even more ominous consideration, although it has not yet been documented, is that any temporary spasm of the distal LAD in a sick patient will clearly divert blood from the proximal LAD into the distal IMA and thus exacerbate the patient's problem.

Thus, the "H" graft and the TRUCAB are two different operations, and in our opinion, neither one is as good as the conventional MIDCAB with direct LIMA-to-LAD anastomosis. Both techniques are in many ways a "poor man's MIDCAB." However, of the two operations, we think the TRUCAB is a better operation; the draining distal limb of the "H" arrangement is the potential Achilles heel of that operation as it may result in significant steal.

The key issue that both the "H" graft and the TRUCAB surgeries have to address is long-term patency. What is clearly needed is a trial comparing conventional MIDCAB to TRUCAB and to "H" graft to see, in fact, what is best for the sick patient in the long run. I suggest that such a trial under the auspices of the Heart Surgery Forum would provide valuable information for MIDCAB surgeons. Just because the TRUCAB and the "H" graft are technically easier to do than

the MIDCAB is not in and of itself a valid reason to do those types of surgery. Wherever possible, the patient should get the full benefit of a direct LIMA-to-LAD anastomosis.

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