



## Editorial

## Graft Spasm—The Achilles Heel of Arterial Grafts



Coronary artery bypass grafting (CABG) surgery has evolved with time. Arterial graft particularly internal thoracic artery (ITA) is proven to be far superior to the saphenous vein graft (SVG). To achieve better long-term results, Total Arterial Revascularization (TAR) was introduced. There are proven reports of long term superiority of TAR. In spite of proven superiority of CABG with TAR technique, the number of patients receiving TAR compared to one ITA and SVG remains dismally low in India<sup>1</sup> and other countries. One of the concerns of using arterial grafts is graft spasm. Incidence of graft spasm is less than 0.5% but it can be devastating in a fourth of the patient who experience graft spasm<sup>2</sup>. No wonder therefore arterial graft spasm is studied extensively. Various technical and pharmacological intervenes continue to evolve. I have the pleasure of introducing innovative organ bath technique for in-situ ITA graft published in this issue of IHJ<sup>3</sup>. It will be pertinent to briefly review contemporary multidimensional approach used in Indian patients to prevent arterial graft spasm.

Preoperative preparation: Preoperative factors for arterial graft spasm include nicotine abuse (both smoking and tobacco chewing) and betel nut chewing. Both nicotine and arecoline (found in betel nut) are powerful vasoconstrictor agents. There is some evidence that nicotine replacement therapy in intensive care unit may increase postoperative mortality after CABG<sup>4</sup>. The reason for this finding may be attributed to the powerful vasoconstrictor effect of nicotine on arterial graft. I personally advocate complete abstinence from smoking, tobacco chewing and betel nut chewing before scheduling a patient for CABG and particularly TAR. In such patients, arteries are often spasmodic and may require multiple antispasmodic agents. There is no published literature on effects of nicotine and arecoline on arterial grafts and this will be an area of future study.

Surgical technique: Harvesting of arterial graft is one of the most important factors. Vascular endothelium secretes very powerful vasodilators and even minimal injury can stop their secretion. It is important to not hold the artery as any intimal damage will may lead to graft spasm. Sketetonized in-situ ITA grafts have higher flows possibly because of the denervation of the artery<sup>2</sup>. On the contrary, free radial artery is always harvested with thin pedicle to prevent arterial intima damage leading to spasm. As radial artery is always used as free graft, nerve supply is severed. There are reports of stelate ganglion block to prevent radial artery spasm<sup>2</sup>. Harmocic scalpel (which uses sound wave) can be used to harvest arterial grafts. Harmonic scalpel causes dilatation of arteries while electrocautery induces spasm. However, use of harmonic scalpel is limited due to large size probe (compared to

electro cautery), availability and added expenditure. Excellent arterial grafts could be harvested using electrocautery with minimal power. These limit popularity of Harmonic scalpel among the cardiac surgical fraternity worldwide. Our experience proves that carefully harvested skeletonized arterial graft are safe even in very high risk patients where graft spasm can lead to catastrophe<sup>5,6</sup>.

Pharmacological intervention: Topical treatment with papavarin is used extensively on both in-situ ITA and free radial artery graft. Radial artery after harvesting is often kept in organ bath of blood with various pharmacological agents (verapamil, diltiazem, nitroglycerin, papavarin, phenoxybenzamin). The same organ bath technique is extended to in-situ ITA graft in an innovative way<sup>3</sup>. This is a helpful technique for all surgeons to remember. Graft spasm is mediated by various mechanisms. Various pharmacological agents have been use to prevent this life threatening complication. No single agent is perfect and a combination of agents may be useful adjunct to perfect surgical techniques<sup>2</sup>. Combination of nitroglycerine and Milrinone has been proven to have more than additive effects. Following agents are clinically useful in dilating arterial grafts and preventing spasm:

1. Nitrates: Nitroglycerine infusion is used routinely during CABG surgery. Major drawback is hypotension.
2. Beta 2 agonist: Dobutamine is used extensively. Major drawback is tachycardia in higher dose
3. Phosphodiesterase inhibitors: Milrinone can be used to dilate arterial grafts
4. Levosumendan: Levosumendan has proven antispasmodic effects on radial artery graft<sup>7</sup>
5. "K" channel opener Nicorandil is a clinically useful drug to prevent arterial graft spasm
6. Ca channel blocker: Diltiazem contributed to successful revival of radial artery graft after it was abandoned for two decades. Verapamil and nifedipine are more powerful in dilating human artery. Dihydropurimidine group e.g. amlodipine dilates arteries and stimulate vascular endothelium to produce nitric oxide.
7. Betablocker: In experimental study dilating effects of beta blockers on arterial grafts has been proven<sup>8</sup>. So liberal use of betablocker is recommended for TAR. One has to be careful to use betablocker after on-pump CABG. However, off-pump CABG patients tolerate betablocker better both during the procedure and postoperatively
8. Carperitide: A Guanyl cyclase activator can be used as antispasmodic drug to prevent arterial graft spasm<sup>9</sup>

There is no single ideal drug to prevent arterial graft spasm, combination of drugs are used often. Personal preference of the author to use NTG and Dobutamine infusion during all off-pump CABG and liberal use of betablockers. If spasmodic artery is detected diltiazem infusion may be added. In patients with left ventricular ejection fraction less than 25%, acute coronary syndrome or intra-aortic balloon pump, we use Levosumendan also. Levosumendan is preferred over Milrinone, but combination of both can be used. Postoperative use of Ca channel blocker is routine – amlodipine is the most preferred drug.

Organ bath technique is a standard of care for use of free arterial grafts particularly radial artery graft. Blood is often used with various antispastic drug combinations (most common is nitroglycerine and verapamil). Papavarine, phenoxybenzamine, levosumendan was also used. Choice of agent is often guided by personal preference, availability and cost. The innovative technique presented here extends 'organ bath technique' to in-situ arterial graft and this is described for the first time in literature. I would recommend this technique without hesitation. But the flow achieved from pedicle ITA after using organ bath is similar to the flow of skeletonized ITA grafts in literature. Complete denervation performed during skeletonization may contribute to prevention of spasm and increase in flow. This technique will be a useful adjunct to careful preoperative cessation of tobacco & betel nut, intra-operative non touch harvesting of arterial grafts and combination of pharmacotherapy (intraoperative & postoperative) to protect 'the Achilles Heel of Arterial Grafts'.

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