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Original Article

Internal Mammary Artery Harvesting by Harmonic Scalpel - Our Experience

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Key Words : *CABG, IHD, Internal mammary artery, Harmonic scalpel*

Abstract:

Internal mammary artery is considered as the priceless conduit in all forms of surgical coronary artery revascularization. Harvesting technique of this artery, as a result, was widely debated. Harmonic scalpel is showing excellent result and some of the pioneers are using it for decades together around the globe disregarding our population. We are routinely using harmonic scalpel from the year 2022 and arranged this study to observe the outcomes in our population.

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Introduction:

The internal mammary artery (ITA/IMA) is considered as the gold standard conduit for coronary revascularization due to its long-term patency and anti-atherosclerotic properties.[1] According to the 2021 ACC/AHA guidelines,[2] when coronary artery bypass grafting is indicated, an IMA, preferably the left one should be used to bypass left anterior descending artery (LAD) revascularization, in indicated cases to improve survival and to reduce recurrent myocardial ischemic attack. Preparation of IMA for grafting to LAD is technically challenging, and over the previous decades different innovative techniques have been introduced by innumerable pioneers with variable results. Harvesting of IMA now-a-days is usually carried out with monopolar electrocautery or fine scissors. However, ultrasonic harmonic scalpel has shown promising result in IMA harvesting as shown by some studies worldwide. No comparative study has been done to see the outcomes of harvesting of LIMA by conventional electrocautery and harmonic scalpel in our population. As a result, we designed our study to compare the quality of IMA and the post-operative in-hospital outcomes between harmonic scalpel and conventional electrocautery group.

Methods:

We started using harmonic scalpel for ITA harvesting from Mar'2022 and till date we are using harmonic scalpel in randomly selected patients undergoing off-pump coronary artery bypass (OPCAB) both through sternotomy and minimal invasive procedure. Any combined procedures, emergency procedures, re-do procedures were excluded from this study. We enrolled 200 patients from Mar' 2022 to Feb '2023 in our study and divided them into two groups, Harmonic group (n=100) and Cautery group (n=100). We recorded harvesting time, number of clips used during IMA take down, pre-anastomosis IMA flows per minute, post-operative chest wound drainage, perioperative myocardial infarction etc. for interpretation and analysis.

Surgical Techniques:

The method of revascularization was through median sternotomy or left anterior thoracotomy, and LIMA was harvested through same incision. After entering the chest, the IMA retractor was used to elevate the sternum and visualize the IMA clearly. The IMA was then harvested using monopolar electrocautery or harmonic scalpel in a skeletonized fashion. The branches were clipped on the IMA side and coagulated on the chest wall side, with cautery but when harmonic scalpel was used branches were sealed with blunt end of harmonic blade (minimum clips were used, if required). IMA was grafted to LAD in a usual manner in beating heart. The other arterial or

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venous anastomoses were performed as directed by pre-operative coronary angiogram in usual manner. After completion of the grafts, protiminization was done and as satisfactory hemostasis were achieved the chest wound was closed leaving RV pacing wire and chest drain tubes in situ. All the patients were then shifted to ICU and monitored for bleeding, vitals and arterial blood gas reports with electrolytes. All data were recorded for interpretation and analysis.

Results:

In between the groups we observed more female patients in the cautery group (13.1% vs 9.7%). We had used almost two third less clips in our harmonic group in contrast to cautery group (11.22 ± 3.98 vs 32.49 ± 3.71). The overall harmonic mammary harvesting time (28 ± 5.65 minutes) was less than the cautery harvesting time (39.87 ± 11.22 minutes). Pre-anastomosis IMA flow (harmonic 100 ± 12.64 ml/minutes vs cautery 101.56 ± 13.39 ml/minutes) was almost equal the both the groups.

Post-operative bleeding (cautery 224.3 ± 51.58 ml vs harmonic 230.6 ± 41.78 ml) was almost similar in both groups. We had no re-opening for bleeding issues in our series.

Figure 1: *Long harmonic hand piece with hook-blade for minimal invasive procedures*

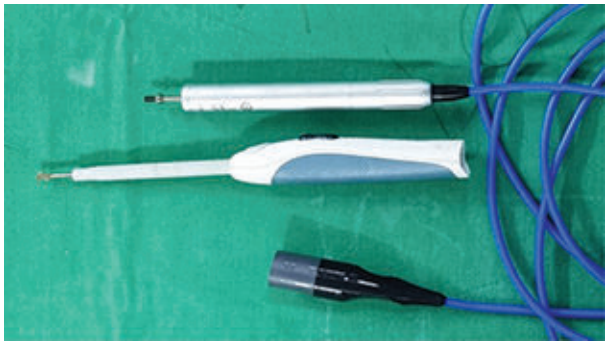

Figure 2: *Short, adjustable harmonic synergy hand piece with hook-blade for sternotomy procedures*

Figure 3: *Harmonic scalpel energy generator by Ethicon (Johnson & Johnson)*

Table-I

Demographic data of both the groups.

Variables	Cautery group (n=100)	Harmonic group (n=100)
Female sex	13.1%	9.7%
Age (Years)	56.32 ± 10.76	56.37 ± 9.28
Body surface area (m^2)	1.74 ± 0.17	1.80 ± 0.64

Table-II

Peri-operative data of both the groups.

Variables	Cautery group (n=100)	Harmonic group (n=100)
Use of clips per patient	32.49 ± 3.71	11.22 ± 3.98
IMA harvesting time (minutes)	39.87 ± 11.22	28 ± 5.65
IMA flow per minutes	101.56 ± 13.39	100 ± 12.64
Post-operative bleeding	224.3 ± 51.58	230.6 ± 41.78
Re-opening for bleeding	-	-

Discussion:

Kieser TM et al, from a review of 1787 ITA conduits, showed a relative less harvesting time (almost half of cautery group) in harmonic scalpel group, as well as less IMA spasm or damage, and minimum use of clips.[3] Yuan SM et al, in a systematic review on 8 articles comprising 1893 patients, explained multiple benefits of harmonic scalpel.[4] These are, reduced thermal injury, superior preservation of endothelium, satisfactory

IMA flow, as well as promising IMA patency. Apart from these, decreased post-operative mortality and morbidity were major noteworthy outcomes. In our series, we observed minimum IMA spasm, no macroscopic IMA or vein injury, almost one third clip requirement, in the harmonic scalpel group.

Although inability to seal a bleeding vessel was the main disadvantage according to Kieser et al,[3] longer harvest time, prolonged operative time and increased hospital expenses were main drawbacks according to Yuan et al.[4] We observed almost similar IMA harvesting time in both the groups. In our initial period (first 30-40 cases), we took almost 40-50 minutes for IMA harvesting which reduced to 25-30 minutes with increased number of cases. Although, operative costs increased due to harmonic machine and accessories, as a whole, post-operative less blood loss, early chest-tube removal resulting in early post-operative mobilization, reduced ICU and hospital stays were observed in the harmonic group, in our study.

Higami et al.[5] evaluated, physiologically and histologically, the branches of ITA harvested by harmonic scalpel. On the basis of distance from origin of the branches, they were divided into three (0, 1, 2 mm) groups. Continuity of the vessel wall were well maintained in the latter two groups, as well as signs of tissue damage were absent in these two groups. We maintained a distance of 1-2 mm from the ITA while cutting the branches of ITA. This way we avoided any visible injury to ITA both in harmonic scalpel or cautery harvested ITA.

Kieser et al,[3] had equal (2.7% vs 3.5%) re-opening rate for bleeding in both the groups. However, we experienced no re-opening in any of our study patients. We think meticulous chest closure, routine use of two units of platelets during protamine administration, had contributed in hemostasis.

Moreover, harmonic scalpel produces no smoke during IMA harvesting thus facilitating mammary harvesting in minimal invasive patients. We experienced no deep sternal wound infection, no post-operative myocardial infarction, no re-operation for early graft failure and no 30 days post-operative mortality in our series.

Conclusion:

Harmonic scalpel although a costly instrument in our context, it makes IMA harvesting easier by reducing thermal injury, reducing venous injury (thus keeping a clean IMA-bed), reducing closing time. Moreover, the IMA harvesting with harmonic scalpel is reproducible technique and most surgeons will be able to acquire it quickly, although a certain learning curve is essential during skeletonization. It reduces the fear of vessel injury during skeletonization of IMA, from the operator's mind, and can be a safe and effective alternative to electrocautery; ultimately patients are benefitted in the long run.

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Limitation:

This is a study with short follow-up and a prospective, longitudinal study should have been conducted with long term outcomes.

Conflict of Interest - None.

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