The Effects Of Internal Mammary Artery Harvesting Techniques On Pulmonary Functions

İnternal Mammaryan Arter Hazırlama Tekniklerinin Akciğer Fonksiyon Testlerine Etkileri

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ABSTRACT

Background: Although it impairs the pulmonary functions, internal mammary artery harvesting with pedunculated or skeletonized technique has been proved to have better long-term outcomes. Even if there is no full consent, some reports insisting on the advantages of skeletonized LIMA harvesting to decrease pulmonary side effect. Our aim is to compare the postoperative respiratory functional status in patients using these two techniques.

Method: Totally 80 patients were included in the study and were divided into two groups; in group P (n=40) LIMA was dissected as a pedunculated graft and in group S (n=40) LIMA was prepared as a skeletonized graft. Pulmonary functions were evaluated on the 6th and 7th postoperative days and were compared between the two groups.

Results: Forced expiratory volume in the 1st second (FEV1) and forced vital capacity (FVC) were the measured data. The decrease in FVC was more prominent in group P ($p<0.05$).

Conclusion: The difference in FVC values demonstrated that skeletonized LIMA harvesting technique might cause lesser restriction of pulmonary functions and may be preferred as it lowers the incidence of postoperative pulmonary dysfunction.

Key Words: Internal mammary artery, pulmonary function tests.

ÖZET

Giriş: Sol internal mammaryan arter (LİMA), kullanılması akciğer fonksiyonlarında bozulmalara yol açmakla birlikte, ister pediküllü ister skeletonize hazırlansın koroner bypass ameliyatlarında geç dönem açıklık oranları en iyi olan grefttir. Henüz kesin görüş oluşmamakla birlikte skeletonizasyon tekniğinin akciğerler üzerine olan yan etkileri azalttığını iddia eden yayınlar vardır. Amacımız akciğer fonksiyon testlerinde bu tekniklere bağlı olarak bir fark oluşup oluşmadığını ortaya koymaktır.

Yöntem: Çalışmaya LİMA'sı skeletonize olarak çıkarılan ardışık 40 hasta (grup S) ve pediküllü olarak çıkarılan yine ardışık 40 hasta (grup P) olmak üzere toplam 80 hasta dahil edildi. Preoperatif ve postoperatif (6. veya 7. gün) solunum fonksiyon testleri karşılaştırıldı.

Bulgular: Solunum fonksiyon testlerinde 1. saniyedeki zorlu expiratuvar volüm (FEV1) ve zorlu vital kapasite (FVC) değerleri ölçüldü. FVC'nin Grup P'de grup S'ye göre daha fazla azaldığı tespit edildi ($p<0.05$).

Sonuç: FVC akciğerlerdeki restriksiyonu gösteren bir ölçüm olup bu çalışma LİMA skeletonize çıkarıldığında daha az restriksiyon geliştiğini göstermektedir. Bu nedenle postoperatif pulmoner disfonksiyon insidansını azaltmak için LİMA çıkarılırken skeletonize tekniğin tercih edilmesinin faydalı olacağını düşünüyoruz.

Anahtar Kelimeler: İnternal mammaryan arter, Solunum fonksiyon testleri.

INTRODUCTION

Internal mammary artery is an ultimately preferred conduit for myocardial revascularization. Whether pedunculated or skeletonized, it has superior late patency rates. In a series of 1046 patients in which bilateral IMA were used, Calafiore et al. reported late patency rates of 98.6 % with pedicled grafts and 98.4% with skeletonized grafts (1). However IMA harvesting carries the potential higher incidence of postoperative respiratory complications (2,3). Few studies published concerning the impact of LIMA harvesting techniques on pulmonary functions which make us feel the need for further researches (4). Skeletonization of LIMA allows better protection of the endothoracic fascia and pleural integrity with selective mobilization of the artery. Lower incidence of pulmonary complications in patients receiving total saphenous vein conduits make the surgeons consider lesser traumatic techniques for LIMA harvesting. This study aims to investigate the benefits of skeletonized LIMA harvesting technique on the postoperative pulmonary functions.

MATERIAL AND METHODS

In 2010, we studied 80 consecutive patients undergoing on-pump coronary artery bypass grafting with LIMA graft. We included into the study the patients without a history of persistent lung disease and with no or mild left ventricular dysfunction of the heart. In group S (n=40) LIMA was harvested according to the skeletonized technique and in group P (n=40) according to pedicled technique. Pulmonary functions were evaluated preoperatively and on the 6th or 7th postoperative day. There were no statistically significant difference according to age, sex, body-mass index, tobacco usage, preoperative cardiac status and existence of diabetes mellitus (Table 1).

Table 1. *Demographic data of the patients.*

Variable	Group S (n=40)	Group P (n=40)	p Value
Age (years)	59.5±8.5	55.7±10.4	NS
Sex (F/M)	9/31	6/34	NS
BMI (Kg/m)	27±4	26±4	NS
Canadian cardio.class	3.3±0.6	3.5±0.5	NS
Smoking (yes/no)	27/13	32/8	NS
Diabetes Mellitus	8	5	NS
CC (min)	59±19	63±17	NS
CPB (min)	76±21	81±18	NS
No of distal anastomoses	3.2±0.6	3.4±0.8	NS

BMI:body mass index, NS: not significant, CC: cross-clamping time CPB: cardiopulmonary bypass time.

The surgical approach was via a median sternotomy. In all patients left pleura was opened and posterior pericardiotomy was made. Cardiopulmonary bypass (CPB) initiated after aortic and two-stage atrial cannulation. Antegrade and retrograde infusion of isothermic blood cardioplegia and topical cooling were used for myocardial protection. LIMA was anastomosed to left anterior descending coronary artery leaving saphenous vein as a conduit for the other remaining anastomoses. Cross-clamp time, total CPB time and number of distal anastomoses did not differ significantly between the two groups. Two draining tubes (mediastinum+left thorax) were inserted in all patients. Early mortality, renal or neurologic complications, intraaortic balloon pump usage, revisions because of postoperative hemorrhage or pump failure were the exclusion criteria of the study. However, these problems did not occur. Patients were usually transferred to the ward on the 1st or 2nd postoperative day and before their discharge on the 6th or 7th day, pulmonary function test was performed.

Results are expressed as the mean±standard deviation and analysis were performed with the use of paired t-test of chi-square. P values less than 0.05 was considered significant (SPSS 10.0, Inc. Chicago Illinois 60606).

RESULTS

To assess respiratory functions; FEV1, FEV1% (showing the ratio of measured value to the expected value), FVC and FVC% were measured. Pre and postoperative values were compared in each group (Table 2 and 3). Decrease of FEV1 in both groups were highly significant ($p<0.001$) while decrease of FVC in group P was highly significant ($p<0.001$) and in group S significant ($p<0.05$). To express in numerical values FVC values decreased 1.02 L as the average in group P whereas 0.68L in group S. This difference was statistically significant ($p<0.05$).

Table 2. *Comparison of Preoperative and Postoperative Pulmonary Functions of Group P.*

Variable	Preop	Postop	p Value
FEV1	2.62±0.94	1.63±0.77	p<0.001
FEV1%	88.07±25.84	54.75±22.36	p<0.001
FVC	3.15±1.01	2.13±0.99	p<0.001
FVC%	87.57±22.46	60.22±25.64	p<0.001

FEV1=forced expiratory volume in 1 second, FEV1%=measured FEV1/expected FEV1x100, FVC = forced vital capacity, FVC% = measured FVC/expected FVCx100.

DISCUSSION

Pulmonary functions are frequently altered after CABG surgery because of various reasons. Common causes are side effects of cardiopulmonary bypass, trauma related to sternotomy, insertion of drainage tubes and LIMA harvesting itself. Many reports have demonstrated that LIMA harvesting during CABG surgery is an adjunctive factor for further impairment of pulmonary function (2,4,5).

Table 3. *Comparison of Preoperative and Postoperative Pulmonary Functions of Group S.*

Variable	Preop	Postop	p Value
FEV1	2.46±1.06	1.84±0.83	p<0.001
FEV1%	77.18±23.65	58.52±24.39	p<0.001
FVC	2.98±1.15	2.30±1.33	p<0.05
FVC%	76.81±25.64	58.79±31.09	p<0.05

Matsumoto et al. studied pulmonary functions of patients undergoing CABG surgery on the 20th and 30th postoperative days and reported almost equal decrease in FEV1 when LIMA is not harvested or harvested as skeletonized graft and much more decrease when LIMA is prepared as a pedunculated graft (4).

Greinecker et al. compared conventional LIMA preparation technique with venoarterial preparation (semiskeletonization) technique and demonstrated that on the 6th postoperative day, FEV1 and inspiratory vital capacity to be significantly higher in the latter group (6). In our study the average decrease in FVC values was 1.02 L in the pedunculated LIMA group and 0.68 L in the skeletonized LIMA group. FVC is an indicator of pulmonary restriction. Both groups did not differ in terms of extubation times, ICU and total hospital stay. However, an average restriction of 1 L in lung capacity may be intolerable for the patients suffering from chronic pulmonary disease and their clinical findings may deteriorate. A study concerning patients with chronic obstructive pulmonary disease may be also valuable.

Effect of pleural sac opening on pulmonary functions is a subject of dispute. Some studies advocate that protection of pleural sac integrity has positive influence on pulmonary functions (3,7). However, there are also studies advocating the opposite (4,8). Pleural sac opening necessitates extra tube insertion into the pleural space, which means a supplementary trauma inducing a painful inspiration and greater respiratory dysfunction. In addition, when pleura is opened, incidence of pleural effusion and need for thoracentesis is significantly higher (3). In skeletonization technique the incidence of pleural opening is significantly lower.

A study which compares the group of saphenous graft used patients with the group of pedunculated LIMA used patients reports that the postoperative pain score is higher in the LIMA used group and this finding may be related to pulmonary function deterioration (2). In an other study comparing pedunculated LIMA, skeletonized LIMA and only saphenous usage demonstrated chronic chest wall pain which was termed as 'post CABG pain syndrome' was much more frequent in LIMA harvested patients without difference in harvesting technique (9). Peterson at al. reported that when skeletonization technique is used, the incidence of chronic chest wall pain and its intensity is lower because anterior branches of intercostal nerves are less frequently injured (10). We did not evaluate postoperative pain in our patients but under highlights of mentioned references, we believe that lesser decrease of FVC in skeletonized LIMA group is also related to lesser postoperative pain.

In conclusion, preparation of LIMA conduit with skeletonization technique causes less reduction in FVC meaning a lesser lung restriction. Therefore, this harvesting technique may be a good alternative especially for patients diagnosed to have pulmonary dysfunction preoperatively.

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