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Determining Changes in Diameter of Internal Carotid Artery Before and After Primary Repair in Carotid Endarterctomy.

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Abstract:

Introduction and Purposes: Cerebrovascular accident (CVA) is the third leading cause of death worldwide. The most common cause of CVA is obstructive lesions of the proximal internal carotid artery, for which a variety of surgical and nonsurgical therapeutic modalities have been proposed.

In the surgical approach (carotid endarterectomy) several different methods have been employed for arterial repair which include primary repair, synthetic or autologous venous patches and eversion endarterectomy. These different methods have led to different outcomes in terms of postoperative arterial diameter and the development of restenosis.

The present article aims at studying the changes in internal carotid artery diameter after primary repair in patients undergoing carotid endarterectomy in shohada-e Tajrish medical center, vascular surgery department.

Materials and Methods: A descriptive cross-sectional clinical study was carried out on 42 operations of carotid endarterectomy performed on 36 patients (Six patients were operated on bilaterally). Arterial repair was uniformly performed by primary repair. The diameter of the artery was exactly measured by a special caliper before and after the operation. Follow-up assessment was performed by color Doppler ultrasound 6 months

after surgery. Any variation in the arterial diameter or development of restenosis was recorded in individual questionnaires and results were statistically analyzed.

Results: In 42 primary repairs of internal carotid artery we had an increase in post operative arterial diameter in 40.5% of cases with a mean increment of 3.17 percent. In 14.2 percent there was no change and in45.3 percent the arterial diameter decreased with a mean of 2.8 percent. Statistically the latter figure was not considered significant based on a T-test study.

Follow-up color Doppler ultrasound performed 6 months after the operation revealed a stenosis up to 25% in 22.7% of patients which was not statistically significant.

Conclusion: This study shows that primary repair of internal carotid artery after carotid endarterectomy does not result in narrowing or recurrent stenosis and therefore could be considered as a safe and satisfactory method of arterial repair. However, the authors recommend further controlled trials to compare this practice with the other methods of arterial repair.

Key Words: Stroke, Endarterectomy, Carotid Diameter.

Introduction:

Adverse consequences of modern technology, sedentary lifestyle, poor dietary habits, smoking, diabetes and obesity have led to a dramatic increase of atherosclerotic diseases and consequently in the incidence of myocardial infarction and cerebrovascular accidents. Currently CVA accounts for the third leading cause of death worldwide. Only in USA it leads to 16000 deaths and a financial burden of 45 billion dollars annually.

Eighty percent of strokes are due to ischemic events and the remainders have hemorrhagic etiology. The most common cause of ischemic stroke (transient ischemic attack or TIA) is obstructive disease of extra cranial carotid arteries (1,2). These include internal carotid artery thrombosis, ischemic events related to decreased cerebral blood flow and cerebral arterial emboli [(2)].

Obstructive diseases of extracranial carotid arteries are managed by different surgical and nonsurgical modalities such as medical treatment, balloon angioplasty, percutaneous stenting and operative endarterectomy.

Two large-scale clinical trials performed worldwide (namely NASCET (North American Symptomatic Carotid Endarterectomy Trial) and ECST (European Carotid Surgery Trial) have shown that surgical intervention significantly reduces the risk of cerebrovascular accidents compared with medical therapy alone [(1)].

In carotid endarterectomy ulcerated or atheromatous plaque is removed with proper technique and then the artery is repaired. Mode of arterial repair is of utmost importance, because inappropriate

closure will increase the risk of thrombosis and intra or postoperative stroke. Preferred technique for arterial repair differs from one center to another. These include primary repair by fine, non absorbable suture material, primary eversion repair, use of venous patch harvested from saphenous and other available veins such as anterior jugular veins and finally synthetic patches such as PTFE (Polytetrafluoroethylene).

Some studies suggest that the use of saphenous vein patch for arterial repair reduces the risk of stroke and mortality rate but may predispose to aneurismal changes [3]. In addition this practice excludes the possibility of performing future procedures such as CABG (Coronary Artery Bypass Graft) or peripheral vascular reconstruction using autologous saphenous vein, which will be required in most of these patients.

In 2005 a study on 1972 patients showed that primary arteriorrhaphy had the poorest results among three different methods including primary repair, eversion technique and venous patch [4]. A study by Band and colleagues showed limited evidence for prevention of restenosis by the use of venous patch, but a reduction in postoperative risk of stroke ad death which was not statistically significant with respect to all causes of mortality [5].

Darling et al. in 2003 showed that eversion endarterectomy reduces the risk of restenosis, so that development of stenosis encountered after primary arterial repair could be avoided by this technique [6].

In 1996 Council et al. showed that venous patch technique is not superior to other methods in terms of reduction in the risk of postoperative stroke, mortality or restenosis [7]. In 1999 two additional studies the first on 133 patients and the other on 178 patients in USA, showed that primary repair of internal carotid artery does not increase the possibility of neurologic events or recurrent stenosis.

In 1994 Myers et al. showed that long term results with the venous patch is not superior to that of primary arterial repair if the internal diameter of internal carotid artery is 5 millimeters or more [8].

In 1989 a study conducted by Clagetti and colleagues showed that with the exception of patients with tortuous internal carotids or an internal diameter of less than 4 mm who are absolute candidates for saphenous patch, this technique does not offer better results and even significantly prolongs the operative time and increases related morbidity.

The main purpose of this study is to determine the range of variation in internal carotid arterial diameter and the development of restenosis after primary repair in carotid endarterectomy.

Materials and Methods:

This is a descriptive cross-sectional study on 42 carotid endarterectomy operations performed on 36 patients in department of vascular surgery, Shohada-e Tajrish Medical Center, Tehran, Iran in a 2005-2006 time period.

First, personal data was registered for each patient in a questionnaire including age, gender, indication for surgery, extent of preoperative stenosis, history of

comorbidities and specific risk factors. The patients were told about the surgical procedure and the nature of study and informed consent was taken.

Under general anesthesia with the patient in supine position and head and neck rotated against the diseased carotid, an incision was made anterior to the sternocleidomastoid muscle, and exploration of common, external and internal carotid arteries was performed. After taking proximal and distal controls the surgeon exactly measured the diameter of internal carotid artery at the site of stenosis by a coulisse with a precision of 0.05 millimeter. After heparinizing the patient and placement of noncrushing clamps, arteriotomy was performed along the common and internal carotid arteries. Intra-arterial shunting was performed, vascular clamps removed and then partial clamps were applied to the arteries. Atheromatous plaque was then dissected and removed off. A search for intimal flap was done and tacked down to arterial wall, if present. Finally the arteriotomy site was primarily repaired by 7.0 monofilament nonabsorbable sutures under proper magnification. There after the same surgeon reexamined the internal carotid arterial diameter and the exact reading was recorded in the patient questionnaire. After meticulous homeostasis and placement of closed suction drains, wound closure and dressing was performed.

Six months after the operation the patients were followed and assessed by color Doppler ultrasound for any evidence of recurrent stenosis. However only 22 patients presented for follow-up visits.

Possible complications were evaluated and recorded postoperatively, during hospital admission and then on a weekly basis and the results were statistically analyzed by paired T-test.

Results:

In the present study 42 carotid endarterectomy operations were performed on 36 patients with 6 patients being operated bilaterally in two separate sessions.

25 patients (69%) were male and 11 (31%) were female. Age of patients varied between 46 to 83 years with a mean of 63.2 years. Indications for surgery included transient ischemic attack (TIA) (46.7%), cerebrovascular accident (24.4%) and reversible ischemic neurologic deficit (RIND) (6.7%).

The patients were also evaluated according to atherosclerotic risk factors with the most common one being arterial hypertension. The average preoperative diameter of internal carotid artery was 5.05mm with a mean of 5.27 mm for men and 4.5 mm for women which was not significantly different (P=0.09).

In symptomatic patients extent of carotid stenosis ranged from 30 to 90 percent, whereas in asymptomatic patients it was between 75% to 90%.

The maximum increase and decrease in arterial diameter following repair was 3.7% and 2.8% respectively which was not statistically different based on a paired T-test study (P~0.5).

In follow-up assessment of 22 patients after 6m months, Doppler sonography revealed an average 25% rate of recurrent stenosis which according to a mean preoperative rate of 76.5% was not statistically significant (P<0.0001).

Table 1– depicts variations in arterial diameter before and after primary repair.

Diameter Changes	Number	percent
Increase in diameter	17	40.5
Without change	6	14.2
Decrease in diameter	19	45.3
Total	42	100

Table 2- Distribution of postoperative complications.

Complication	Number	Percent
Hematoma	3	7.1
Perioperative transient ischemia	1	2
Death Perioperative	1	2
Wound infection	0	0
Cranial nerve injury	0	0
Total	5	11.1

Discussion:

Although first reports of successful carotid endarterectomy date back to early 1950's but the best method for arterial repair after endarterectomy is still a matter of controversy. The main theoretical advantage with the use of venous patch is an increase in arterial luminal diameter. However the use of venous patch produces a pool of unwanted smooth muscle and endothelial cells which lead to intimal hyperplasia, increasing the chance of restenosis [8]. Distensibility of the saphenous vein may lead to aneurismal changes of the venous patch [3]. Also the venous patch increases both the operative time and the chance of hematoma formation. In our study there was either no change in external diameter (14.1 percent) or even increased in 40.5 percent of cases, which is due to partial removal of arterial intima and media. In 45.3 percent of patients the decreased postoperative diameter was estimated about 2.8 percent which was not statistically significant.

Ultrasound examination performed 6 months after the operation in half of the patients revealed no significant sign of restenosis.

According to the literature, restenosis refers to stenoses of at least 50 percent, whereas in our study the highest reported stenosis was 25% which occurred in primary narrow native arteries. In our study the minimum and maximum arterial diameter measured preoperatively were 4.12 and 6.67 millimeters respectively, with a mean diameter of 5.27 mm in men and 4.51 mm in women, with no significant difference between the two groups ($P<0.05$).

Only in one study the diameter of artery was measured by calipers, in which the average diameter of artery was 4.6 mm in men and 4.3 in women.

Surgeon's experience and number of his or her previous successful operations play an important role in the surgical outcome, as was the case with excellent results in our study. Only 3 out of 42 patients developed wound hematoma which was managed conservatively but one patient needed open wound management.

Unilateral neurologic deficit was encountered postoperatively in only one patient in whom color Doppler examination confirmed carotid artery patency. The patient's symptoms were alleviated after 4 hours and the patient was discharged with optimal condition.

Postoperative death occurred in only one patient which may be due to intracranial

hemorrhage (ICH). Patency of carotid artery was also confirmed in this patient before death.

It is concluded that meticulous primary repair of carotid artery dose not lead to narrowing or recurrent stenosis of arterial lumen. Other advantages include shortened time for arterial clamping, reduced operative time, avoiding difficulties with the use of venous patch and reserving greater saphenous vein for probable future procedures such as CABG which will be required in most of these patients. Therefore primary repair of internal carotid artery is considered a safe and satisfactory method of arterial repair in carotid endarterectomy.

Last but not least, the authors of this article recommend further controlled trials to compare and select the best method of arterial repair in carotid endarterectomy.

References:

1. Schwartz's Principles of surgery, Mc Graw Hill, 2005, 780-788.

2. Rutherford Text of Vascular Surgery, Saunders, 2005, 1881-1895.

3. Wiley W, Mitchell P. ACS Surgery. Principles and Practice, Web MD 2004, pp:657-677, 747-762.

4. Rockman Caron B, Halm Ethan A, Wang Jason J and et al. primary closure of the carotid artery is associated with poorer outcomes during carotid endarterectomy, J Vasc Surg 2005; 42(5): 870-877.

5. Bond R, Rerkasem K, Naylor AR, Aburahama AF, Rothwell PM. Systemic review of randomized controlled trials of patch angioplasty versus primary closure and different types of patch materials during endarterectomy. J Vasc Surg. 2004; 40(6): 1126-35.

6. Darling RC 3rd, Mehta M, Roddy SP, Paty PS and et al. Eversion carotid end arterectomy: a technical alternative that may obviate patch closure in women. Cardiovasc surg. 2003 Oct; 11(5): 347-352.

7. Councill C, Salinas R, Warlow C, Naylor R. Cochrane Database Syst Rev. 2000; (2): CD000160.

8. Pappas D, Hines GL, Yoonah Kim E. Selective patching in carotid endarterectomy: is patching always necessary? J Cardiovascular Surg (Torino). 1999 Aug; 40(4): 555-9.

9. Andersaon A, Padayachee TS, Sandison AJ, Modaresi KB, Taylor PR. The results of routine primary closure in carotid endarterctomy. J Cardiovasc surg. 1999 Jan; 7(1): 50-5.

10. Myers SI, Vaslentine RJ, Cherru A, Bowers BL, Clagett GP. Saphenous vein patch versus primary closure for carotid endarterectomy: long – term assessment of a randomized prospective study. J Vasc Surg. 1994 Jan; 19(1): 15-22.

11. Clagett GP, patterson CB, fisher DF Jr and et al. vein patch versus primary closure for carotid endarterectomy. A Randomized prospective study in a selected group of patients. J Vasc Surg. 1989 Feb; 9(2):213-23.