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Internal Jugular Vein Graft after Inadvertent Severing of the Internal Carotid Artery during Carotid Endarterectomy and an Urgent Re-Exploration for Immediate Post-Operative Wound Site Bleeding: A Case Report

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Abstract

Carotid endarterectomy is a well-established treatment for preventing stroke in selected patients. Although there is debate over whether patch angioplasty or primary closure should be used to reconstruct the bifurcation after carotid endarterectomy, there is growing evidence in the literature in favor of patch angioplasty. When compared to primary closure, patch angioplasty during conventional carotid endarterectomy is suggested to lower the incidence of restenosis and recurrent ipsilateral stroke. Various materials have been used as a patch in this procedure, including the saphenous vein, synthetic patches, or less frequently, an internal jugular vein patch where extensive narrowing of the internal carotid artery is evident. In our case, we used an internal jugular vein graft after inadvertent severing the internal carotid artery (ICA) during carotid endarterectomy after the failure of reconstruction with a saphenous vein patch. We also encountered immediate postoperative reactionary hemorrhage following anesthetic reversal, necessitating an urgent re-exploration. The purpose of this case report is neither an attempt to suggest all patients need angioplasty nor to state that an internal jugular vein patch or graft is superior to synthetic material or saphenous veins; rather, it is an attempt to emphasize a potentially effective rescue way to reconstruct inadvertent extensive vascular injury during carotid endarterectomy.

*Prof. Md Shafiqul Islam is the corresponding author.

Keywords

Carotid Endarterectomy, Internal Jugular Vein Graft, Venous Patch, Reactionary Hemorrhage

1. Introduction

Carotid artery endarterectomy (CEA), first described by Eastcott and colleagues in 1954 [1], has remained the standard treatment option for both symptomatic and asymptomatic patients with significant carotid stenosis. Every year in the US, about 100,000 CEAs are conducted [2] [3]. The majority of patients with carotid illness are still managed through open surgery, despite the fact that minimally invasive carotid artery angioplasty and stenting are the topics of much discussion in the treatment of carotid artery stenosis [4] [5]. Carotid endarterectomy is frequently followed by patch angioplasty. According to randomized prospective trials and meta-analyses, there are better rates of perioperative and long-term stroke prevention as well as lower rates of restenosis for patches compared to primary closure of the arteriotomy. Even though vein patches are the "gold standard" for patch closure, more recent generations of synthetic and biological materials have produced results that are competitive with vein patch results [6]. The ideal requirements for any patching material include: 1) long-term stability and durability, 2) low risk of restenosis, 3) compliance near that of the host artery, 4) comfortable handling characteristics, 5) easy harvest or ready to use, 6) anti-coagulant function, and 7) resistance to infection and late degeneration. Patch material may be made from an autologous vein (saphenous, internal jugular vein), bovine pericardium, or synthetic material, including polytetrafluoroethylene (PTFE), Dacron, polyurethane, and polyester [7]. It is noteworthy that the initial material used for CEA patching was an autologous vein. Imparato was a pioneer in advocating for the routine use of venous patches to avoid restenosis [8]. The most popular approach for arterial patching during CEA continues to be autologous venous tissue patching, which continues to produce excellent results in the literature. Because it is often used, is easy to handle, and resistant to thrombosis and restenosis because of its endothelial coating on the luminal surface, this patch is still a favorite among surgeons [9]. The internal jugular vein is a great source of autogenous tissue for carotid artery reconstruction since it can be accessed through the surgical incision, is of an appropriate size, and may be collected without causing any morbidity [10]. A study demonstrated the role of an IJV patch and concluded that an internal jugular vein patch is a safe alternative to synthetic graft and saphenous vein when angioplasty is indicated following carotid endarterectomy [11]. In our patient, though the plan was to use a saphenous vein patch, we used an internal jugular vein graft because of inadvertent severing of the ICA during plaque removal, and the harvested saphenous vein was not adequate for proper reconstruction. In

addition, in the immediate postoperative period, the patient experienced reactionary hemorrhage from surgical wound site that required urgent re-exploration. We emphasized the potential unforeseen challenges that may come along with the procedure, such as vascular injury and hemorrhage, and how to manage them.

2. Case Report

Our patient, Mr. Suman, a 30 years old male, presented with right-sided hemiparesis and expressive aphasia and was diagnosed as having a stroke. CT scan of the brain revealed subtle hypodensities at the left temporo-parietal region involving the capsulo-ganglionic area consistent with ischemic change (Figure 1). MRI brain demonstrated acute infarct in left fronto-temporo-parietal region involving capsulo-ganglionic paraventricular location (MCA territory) (Figure 2). Digital subtraction angiography (DSA) revealed stenosis (75% stenosis) at the

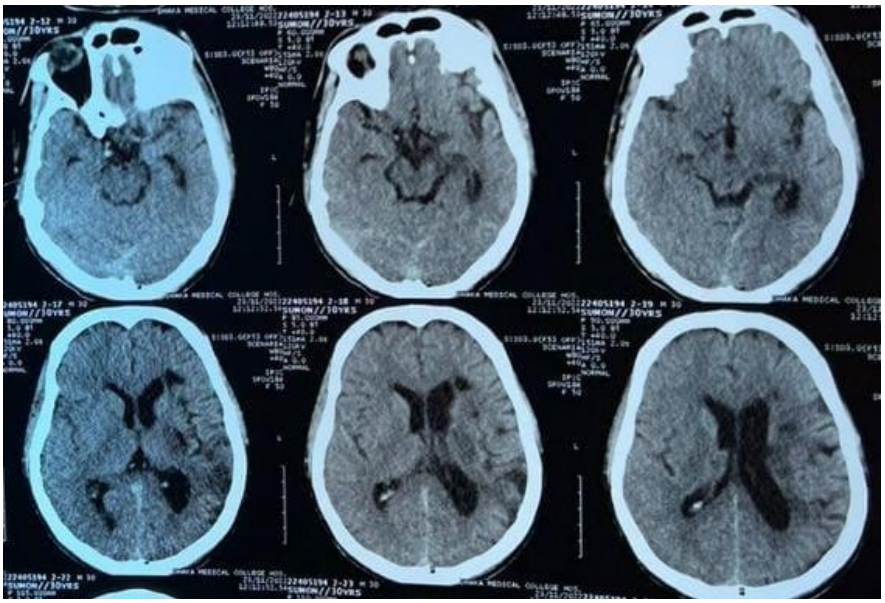


Figure 1. CT scan of brain revealed subtle hypodensities at left tempero-parietal region involving capsuloganglionic area resembling watershed infarct involving ACA and MCA territory.

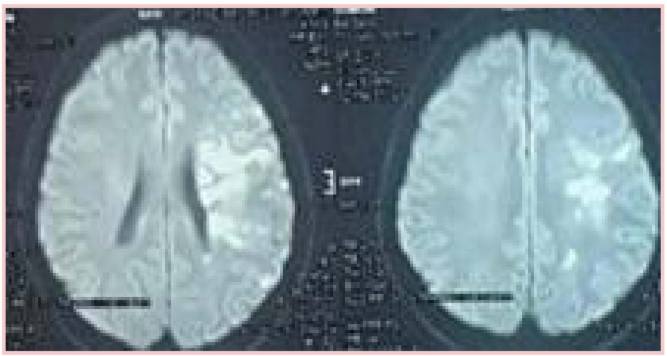
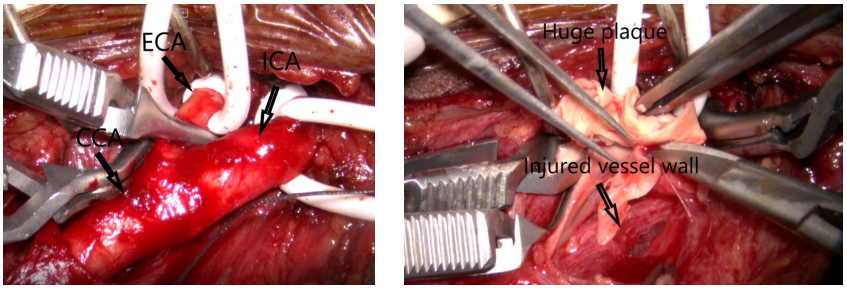


Figure 2. MRI brain DWI axial section demonstrated deep acute white matter infarct in left fronto-temporo-parietal region involving capsuloganglionic paraventricular location.

origin of the left internal carotid artery (ICA) (Figure 3). Blood workups for vasculitis such as cANCA, pANCA, came out negative. We planned for carotid endarterectomy with saphenous vein patch angioplasty. Intraoperatively, a large atherosclerotic plaque was found adherent to the posterior walls of the ICA and CCA (Figure 4). During removal of the plaque, the posterior wall was severed inadvertently (Figure 4). Reconstruction has been tried with a saphenous vein patch, but it failed (Figure 5). Following that, a decision was made to use an internal jugular vein graft in the vicinity, and an end-to-end anastomosis was performed (Figures 6-9). In the immediate postoperative period, blood started to come out through the drain tube, and the patient went into shock. The patient has been taken to the OR immediately, and an urgent re-exploration has been carried out. An anastomotic gap was noted in the posterior wall of the distal part of the anastomosis, which was repaired by three interrupted sutures (Figure 10 and Figure 11). We suspected this happened because of high blood pressure (Recorded BP 190/120mmhg). Post-operative DSA showed patent anastomosis with good distal flow (Figure 12) and venous drainage by only the right IJV (Figure 13). We ensured mild sedation and strict monitoring of BP in the early postoperative period. The patient made a quick recovery with significant improvement in speech and limb movements (Figure 14). He is now on our regular follow-up schedule.

Figure 3. Digital subtraction angiography (DSA) lateral view revealed stenosis (75% stenosis) at the origin of the left internal carotid artery (ICA).



(a) (b)

Figure 4. (a) Bifurcation of common carotid artery; (b) Inadvertent injured vessel wall during removal of large atherosclerotic plaque adherent to the posterior walls of the ICA and CCA.

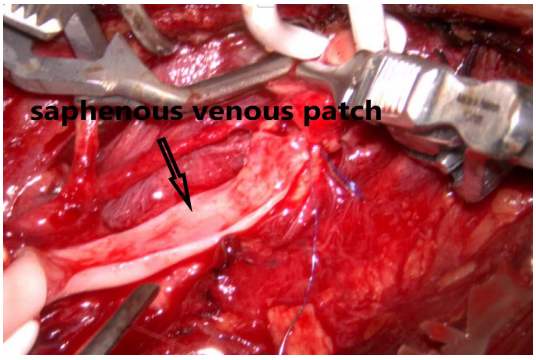


Figure 5. Attempt of reconstruction of the injured vessel by saphenous vein patch.

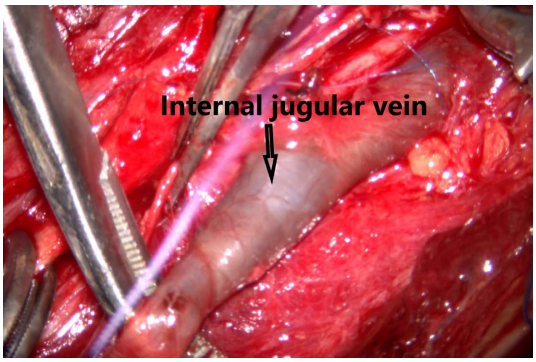


Figure 6. Further dissection to harvest IJV graft in vicinity.

Figure 7. IJV Harvesting.

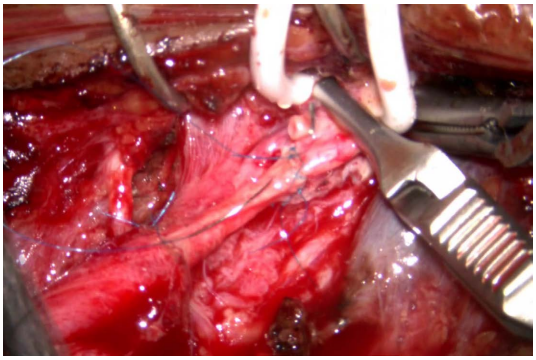


Figure 8. Anastomosis by suturing.

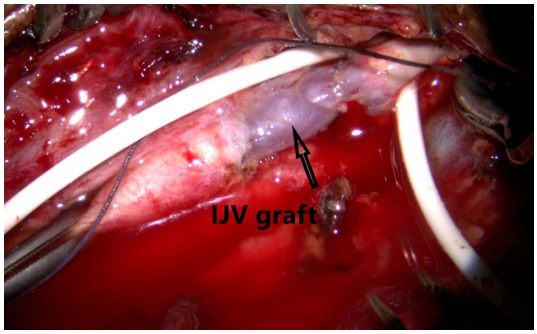


Figure 9. End to end anastomosis with IJV graft.

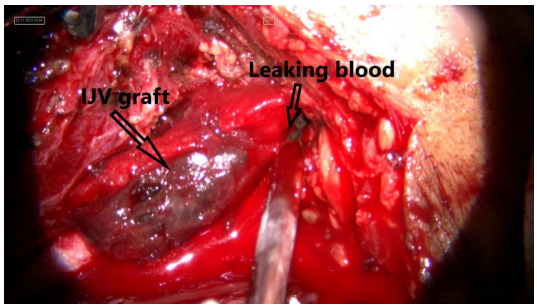


Figure 10. Urgent re-exploration to address immediate postoperative bleeding.

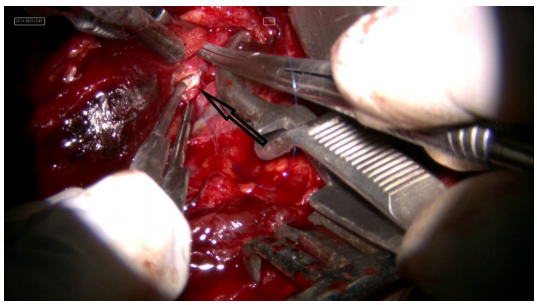


Figure 11. An anastomic gap is noted in the posterior wall of the distal part of the anastomosis (arrowed) after meticulous exploration which is secured by multiple interrupted prolene suture.

Figure 12. Postoperative DSA showed patent anastomosis (arrowed) with good distal flow.

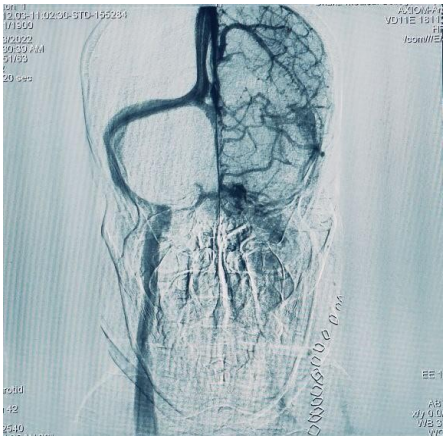


Figure 13. Postoperative DSA shows venous drainage by right internal jugular vein.

Figure 14. Postoperatively patient made quick recovery with significant improvement in speech and motor function.

3. Discussion

There have been many reports comparing the results of carotid endarterectomy (CEA) after the use of autologous or synthetic patches. Most analyses have shown that there are no significant differences in early outcomes when comparing venous with prosthetic patches [5] [12] [13] with a very low risk of any events. O'Hara reported the results from the Cleveland Clinic, which randomized 207 cases to vein or synthetic patch closure; the stroke rate in the vein patch group was 3.0% compared to 2.1% in the synthetic patch group ($p = 0.99$). Recurrent stenosis (>60%) was present in 4.8% of the vein patch group compared to 6.3% of the synthetic patch group ($p = 0.99$) [14]. One study examines the long-term clinical outcome and the incidence of recurrent stenosis (> or =50%) after carotid endarterectomy (CEA) with primary closure (PC) versus vein patch closure (VPC), saphenous (SVP), and jugular vein (JVP), and polyte-

trafluoroethylene patch closure (PTFE-P) A total of 399 CEAs were randomized into the following groups: 135 PC, 134 PTFE-P, and 130 VPC (SVP alternating with JVP), and they concluded patch closure (VPC or PTFE-P) is less likely than PC to cause perioperative stroke. Patching was also superior in lowering the incidence of late recurrent stenoses, especially in women [15]. In 2004, Bond and colleagues reviewed the outcome of 7 randomized trials that compared primary closure with patch angioplasty after CEA [16] [17]. These 7 randomized trials, involving 1281 procedures, showed that patch angioplasty is associated with a reduced 30-day risk of ipsilateral stroke (1.6% vs. 4.8%, p = 0.001), a reduced risk of stroke or death (2.5% vs. 6.1%, p = 0.007), reduced rates of return to surgery (1.1% vs. 3.1%, p = 0.01), and reduced rates of arterial occlusion (0.5% vs. 3.6%, In addition, carotid patching was associated with reduced long-term rates of ipsilateral stroke (1.6% vs. 4.8%, p = 0.001), reduced risk of stroke or death (14.6% vs. 24.1%, p = 0.004), and reduced rates of recurrent stenosis (4.8% vs. 18.6%, p = 0001) compared to primary closure. This meta-analysis provides strong evidence that carotid patching provides both perioperative and long-term benefits for patient care, and is consistent with the standard use of patching during CEA. The benefit that is probably the most generally agreed upon is the reduced rate of restenosis in the long term. Therefore, in our case, we planned to use saphenous vein patch angioplasty following carotid endarterectomy. Intraoperatively, due to the inadvertent severing of the ICA during huge plaque removal, the harvested saphenous was not adequate enough to reconstruct the injury. With no delays, we decided to take internal jugular vein (IJV) graft in vicinity for proper reconstruction. There are many reports supporting the ligation of the IJV in neck dissection, despite some potentially rare complications. A study demonstrated that one-sided ligation of the internal jugular vein in children does not cause cerebral hemodynamic and liquor-dynamic disorders and does not influence functional status of the brain in the short-term and long-term postoperative period [18]. In another study, a total of 17 patients requiring resection of the internal jugular vein were evaluated prospectively using magnetic resonance imaging and 2-dimensional (time-of-flight) magnetic resonance angiography after the surgical treatment. Intracranial thrombosis with thrombosis of the sigmoid sinus was found in 4 patients, and thrombosis of the transverse sinus was found in 3 patients. There were no complications, such as intracranial hemorrhage or signs of increased intracranial pressure, in any patients. There was no evidence of intracranial thrombosis in 10 cases. They concluded although intracranial thrombosis of the sigmoid or transverse sinus seems to occur more frequently than was previously thought, intracranial complications such as venous infarction or increased intracranial pressure appear to be very rare. After unilateral radical neck dissection, the venous blood leaves the brain mainly via the venous system of the other side of the neck and the ipsilateral collateral veins [19]. Early diagnosis and aggressive therapeutic interventions are critical to prevent further morbidity in patients who develop cerebral vein and dural sinus thrombosis after ligation of the internal jugular vein [20]. Another potential

complication is diplopia, although very rare after unilateral IJV ligation, which should be kept in mind. Magnetic resonance venography (MRV) is the investigation of choice to ascertain the underlying etiology [21]. Regarding complications following CEA, these can be related to underlying cardiovascular disease or other comorbid conditions, or to the technique of performing carotid endarterectomy. Postoperative complications of CEA, including myocardial infarction; perioperative stroke; postoperative bleeding; and the potential consequences of cervical hematoma, nerve injury, infection, and carotid restenosis, which may require repeat carotid intervention [22]. Although noninfectious rupture of saphenous vein patches in the early postoperative period has been reported by several authors [23] [24], there has been no report to date in the literature to the best of our web search regarding the use IJV graft as rescue way in a setting of vascular catastrophe like extensive carotid injury during endarterectomy. Moreover, we witnessed the immediate postoperative wound site bleeding within 1 hour of anesthetic reversal. The patient went into shock and was taken to the OR for urgent re-exploration, which required securing the distal anastomotic leak with multiple interrupted prolene sutures. Note, during bleeding the BP recorded high at around 220/120 mmhg in the postoperative recovery room. We suspected that this happened because of raised BP. After achieving hemostasis, we observed anastomotic patency by increasing BP intraoperatively for a while. In the postoperative recovery room the blood pressure maintained strictly within normal limits with mild sedation of the patient for few days and the patient made an uneventful quick recovery with significant improvement in speech and limb movements.

4. Conclusion

Though it is commonly practiced by surgeons, considering a saphenous vein patch is preferable to primary closure and other types of patches in the case of patch angioplasty, the possibility of unforeseen vascular catastrophes should be kept in mind, like an intraoperative extensive inadvertent vascular injury that is difficult to reconstruct by patch angioplasty, where the use of an IJV graft can be justified in a rescue setting because it may reduce the risk for early and late recurrent stenosis and thus the long-term risk for ipsilateral ischemic stroke. Immediate postoperative close monitoring, including blood pressure maintenance, can play a critical role in preventing and managing a rare but fatal complication such as a vascular anastomotic leak.

Conflicts of Interest

There were no conflicts of interest, according to the authors, during the planning and writing of this paper.

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