International Journal of General Practice Nursing, 2024, Volume 2, Issue 2
https://ojs.bbwpublisher.com/index.php/IJGPN
ISSN Online: 2981-9423
ISSN Print: 2981-9415

Analysis of the Effect of Endarterectomy and Carotid Stenting Applied to Patients with Carotid Artery Stenosis

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Abstract: *Objective*: To explore the effect of endothelial stripping and carotid stenting applied to patients with carotid artery stenosis. *Methods*: 90 patients with carotid artery stenosis were selected and divided into 2 groups by equal randomization method, with 45 cases in each group. One group was subjected to endothelial debridement and the other group was subjected to carotid artery stenting. The evaluation scales corresponding to the perioperative indexes of the two groups were compared and evaluated. *Results*: The operative time, intraoperative bleeding, and postoperative pain scores of CEA patients were significantly better than those of CAS, with statistically significant differences ($P < 0.05$). The incidence rate of vascular events in CAS patients (4.44%) was lower than that of CEA (20.00%), with statistically significant differences ($P < 0.05$), and the postoperative blood pressure recovery time of CAS patients was significantly better than that of CEA, with statistically significant differences ($P < 0.05$). *Conclusion*: CEA and CAS are both effective methods for treating carotid artery stenosis, and it is necessary to choose the most suitable method in the process of treatment in combination with the actual situation of the patient, to obtain the best therapeutic effect. For patients with more severe carotid artery stenosis or unstable plaques confined to the opening of the internal carotid artery, it is more suitable to choose the CAS method.

Keywords: Endarterectomy; Carotid stenting; Carotid stenosis

Online publication: July 3, 2024

1. Introduction

Carotid stenosis is the narrowing of the internal carotid artery or its branches that results in reduced or interrupted blood flow to the carotid arteries. The internal carotid artery system is the main source of the middle and posterior cerebral arteries and is the site of the greatest blood flow to brain tissue [1]. Carotid artery stenosis and cerebral ischemia are closely related and can lead to ischemic stroke [2]. As the population ages, the incidence of carotid artery stenosis tends to increase each year. About 600,000 patients with carotid stenosis undergo carotid endarterectomy (CEA) and carotid artery stenting (CAS) each year in the United States [3]. Both CEA and CAS are surgical procedures to address carotid stenosis and can be performed to lower blood pressure

and improve the endovascular environment to control disease progression [4]. Despite the successful outcomes of both surgical approaches, there are many differences between them, and CEA and CAS have different outcomes for different types of carotid stenosis. This article focuses on comparing the advantages and disadvantages of CEA and CAS in treating patients with carotid artery stenosis to provide a reference basis for clinical treatment.

2. Information and methods

2.1. General information

Ninety patients with carotid artery stenosis were selected and divided into 2 groups by equal randomization method, each group consisted of 45 patients, aged 41–82 years, weighing 50–80 kg. One group underwent endothelial debridement and the other group underwent carotid artery stenting.

2.2. Methodology

2.2.1. Endothelial debridement

During routine general anesthesia, the patient was lying down, the surgical site was disinfected and toweled, and an oblique incision was made, with a length of about 6–8 cm. The skin, subcutaneous tissue, and the broad neck muscle were incised sequentially, the carotid artery sheath was free and incised, and the common carotid artery, internal carotid artery, and external carotid artery were separated and blocked, the artery was incised longitudinally, and the endothelium was stripped off by applying the stripper, the endothelium piece was fixed, and the incision was closed with a nondestructive suture.

2.2.2. Carotid stenting

Local anesthesia operation, femoral artery puncture, placement of guiding catheter, under the premise of placing a brain protection device, with a micro-guidewire to guide the balloon dilatation to the stenosis site for dilatation, after positioning accurate dilatation of the balloon to release the stent.

2.3. Observation indicators

The evaluation scale corresponding to the perioperative indicators of the two groups was evaluated by comparing the higher scores.

2.4. Statistical methods

SPSS 22.0 software was used to process the data, and the comparison of the measurement data was done by independent samples *t*-test, and $P < 0.05$ was regarded as a statistically significant difference.

3. Results

3.1. Clinical outcomes in both groups

The operative time, intraoperative bleeding, and postoperative pain scores of CEA patients were significantly better than those of CAS, and the difference was statistically significant ($P < 0.05$). It is shown in **Table 1**.

Table 1. Comparison of clinical outcomes between the two groups

Groups	Surgical time (min)	Intraoperative bleeding (ml)	Postoperative pain score
CEA (n = 45)	42.36 ± 11.45	14.32 ± 2.04	3.45 ± 0.41
CAS (n = 45)	71.21 ± 10.78	19.36 ± 2.14	4.36 ± 0.37
t	12.306	9.263	9.025
P	<0.05	<0.05	<0.05

3.2. Complication rates in both groups

The incidence of cerebrovascular events in CAS patients (4.44%) was lower than that in CEA (20.00%), with a statistically significant difference ($P < 0.05$), and the postoperative blood pressure recovery time in CAS patients was significantly better than that in CEA, with a statistically significant difference ($P < 0.05$), as shown in **Table 2**.

Table 2. Complication rates in both groups [n (%)]

Groups	Number of cases	Cerebrovascular incidence	Postoperative blood pressure recovery time (min)
CEA	45	9 (20.00)	30.12 ± 2.41
CAS	45	2 (4.44)	25.12 ± 2.47
X^2		5.455	7.936
P		<0.05	<0.05

4. Discussion

When choosing the type of surgery, the patient's age, degree of stenosis, blood pressure, and other factors, such as the presence or absence of comorbid cerebrovascular disease, are taken into account. For younger patients who do not have stroke, severe hypertension, or diabetes, CEA can be considered [5]. However, CEA is not recommended for patients with severe risk factors for stroke, or patients with coexisting hypertension or diabetes mellitus. In addition, CEA should take into account the type of vascular lesion and the degree of stenosis. Currently, there are three most common types of carotid stenosis in clinical practice: simple (1/4), mixed (2/3), and stenotic (1/4-2/3). Approximately 40%–50% of patients with simple carotid stenosis require CEA, while approximately 80% and 60% of patients with stenotic and mixed carotid stenosis, respectively, require CEA [6]. Therefore, CEA is not recommended for patients with other conditions affecting the vasculature. CAS is mainly used for carotid occlusion or occlusive lesions. CAS is usually required for occlusive lesions, while CEA is required for symptomatic stenosis or occlusive lesions, such as >50% stenosis [7]. In clinical practice, although CAS is usually indicated for symptomatic stenosis or occlusive lesions, it should be tailored to the patient's individual situation [8–9]. For patients with asymptomatic stenosis or occlusive lesions who do not require CAS, CEA may be preferred.

In this study, operative time (CEA 42.36 ± 11.45 vs CAS 71.21 ± 10.78), intraoperative bleeding (CEA 14.32 ± 2.04 vs CAS 19.36 ± 2.14), and postoperative pain scores (CEA 3.45 ± 0.41 vs CAS 4.36 ± 0.37) were observed ($P < 0.05$). This was mainly because routine aortic arch and carotid angiography and selective whole-brain angiography were first performed for CEA to identify the lesion. The distal umbrella was delivered via a guiding catheter to pass the stenosis to a predetermined location distal to the stenosis of the internal carotid

artery (at least 3 cm distal to the stenotic lesion) for release of the EPD. The stenotic lesion was more than 90% (proximal to the occluded lesion), to prevent difficulty in passage of the EPD and to minimize the risk of embolus dislodgement. It is recommended that a small balloon (2.5 mm in diameter) be pre-dilated before passing the carotid umbrella delivery device through the stenotic lesion. The carotid umbrella procedure allows passage of blood flow but captures the dislodged emboli, and balloon dilatation and stenting of the stenotic carotid artery is performed through either the distal guard's guidewire or a therapeutic guidewire placed proximal to the guard. The balloon pre-dilatation technique is recommended for severely stenotic lesions. Post-dilatation is often no longer required for self-expanding carotid stenting after dilatation. If residual restenosis is >30% after stent implantation, a 5–6 mm balloon is used for post-stenting. Carotid angiography is performed immediately after stent implantation to visualize the carotid arteries for filling defects (emboli), and after confirming the absence of such defects, the EPD is recovered and flushed ex vivo to confirm that red and white emboli have been captured. Carotid and intracranial angiographic evaluation of the treated side was performed again, and the surgical operation was completed when satisfactory morphological efficacy was achieved and no complications such as cerebral ischemia were detected [10].

The CAS procedure takes longer (1 to 3 hours) and requires cerebral oxygen monitoring equipment because the entire procedure requires intravascular ultrasound and localization using intraoperative ultrasound (IVUS), and because carotid artery blood flow needs to be completely blocked during the procedure. Therefore, for beginner surgeons, the procedure time is longer and the risk is higher. CEA, on the other hand, has a shorter procedure time (30–60 minutes) and lower risk, but because it requires the use of a balloon for dilatation, it is also more risky for patients with poorer vessel wall conditions. Although CEA can accomplish the surgical treatment process with a dilated balloon, overexpansion of the balloon can lead to stent leakage and collapse [11]. Overall, the CAS procedure is long, invasive, and risky; the CEA procedure is short, less invasive, and less risky; however, because the CEA procedure requires the use of a balloon for dilation as well as stenting, it may be limited for patients with poor vascular conditions and extensive lesions [12–13].

The results of this study showed that the postoperative blood pressure recovery time (CAS 25.12 ± 2.47 vs CEA 30.12 ± 2.41), among all patients, the complication rate of CAS patients 4.44% was significantly lower than that of CEA 20%, and the difference was statistically significant ($P < 0.05$). The postoperative complications mainly included thrombosis, stroke, carotid artery entrapment, stenosis hemorrhage, and so on. Postoperative complications were less due to CAS compared to CEA as it provides better hemodynamic control. The major postoperative complication of CEA compared to CAS is stroke. Relevant studies have shown that transient ischemic attack (TIA) occurs in about 1% of patients after CAS, whereas after CEA, this percentage is as high as 30% [14]. Some reports have shown that the incidence of stroke occurring 4 to 6 months after CEA surgery is about 10% to 25% [15]. The postoperative efficacy of CEA depends on the degree of carotid artery stenosis and the severity of the patient's condition, and preoperative examinations should include carotid arteriography, cranial MRI or CT angiography, and so on. As carotid artery stenosis is different in different parts of the body, and therefore the postoperative complications are also different, carotid angiography is an important means to diagnose the stenosis before operation. Carotid angiography can directly show the degree of carotid artery stenosis and the extent of lesions, as well as the distribution of plaques, providing a reliable basis for evaluating the effectiveness of surgery. The degree of carotid stenosis can be indirectly assessed by the contralateral internal carotid artery. At 6 months after CAS, the mean internal diameter of the internal carotid artery decreased significantly compared with the preoperative level; at 1 year after surgery, the mean internal diameter of the internal carotid artery increased significantly compared with the preoperative level; and at 3 years after surgery, the mean internal diameter of the internal carotid artery began to return to the preoperative

level again. Studies of carotid plaques have shown that a higher proportion of patients have lost or thinned plaques after CAS than after CEA, and only a fraction of patients with thinned plaques after CEA had changes in plaque morphology. Carotid endarterectomy is a surgical procedure in which the vessel is stripped and the diseased area removed through a surgical incision. Although CAS has a higher safety and efficacy profile than CEA, CEA has a better therapeutic effect in some patients with mild carotid stenosis or specific lesion locations. Therefore, CEA is more appropriate for patients with mild carotid artery stenosis or special lesion locations. Although CEA and CAS show similar advantages in clinical treatment, there are still significant differences between them. First, the degree of carotid artery stenosis is different, and the surgical methods are also different. Second, the scope of surgery is different, as CAS can only strip the lining of the beginning of the internal carotid artery, while CEA can treat stenotic lesions in multiple locations. Lastly, there is also a certain difference in the postoperative complications. CEA and CAS both have very good results, but there is still a lot of need to be improved and perfected for the treatment of carotid stenosis by CEA and CAS.

In summary, both CEA and CAS are effective methods for treating carotid artery stenosis, and it is necessary to choose the most appropriate method in the course of treatment in combination with the actual situation of the patient to obtain the best therapeutic effect. It is more suitable to choose CAS for patients with more severe carotid artery stenosis or unstable plaques confined to the opening of the internal carotid artery.

Disclosure statement

The author declares no conflict of interest.

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