American Journal of Case Reports

e-ISSN 1941-5923
© Am J Case Rep, 2019; 20: 15-20
DOI: 10.12659/AJCR.912769

Received: 2018.08.15
Accepted: 2018.10.05
Published: 2019.01.04

Transcervical Carotid Artery Stenting without Flow Reversal: A Report of Two Cases

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

E Mahmoud Assaad
EF Abeer Berry
E Marcel Zughaib

Department of Cardiology, Providence and Providence Park Hospitals, Southfield, MI, U.S.A.

Corresponding Author: Abeer Berry, e-mail: a9abeer@gmail.com
Conflict of interest: None declared

Case series
Patients: Male, 78 • Male, 69
Final Diagnosis: Severe carotid artery stenosis
Symptoms: Asymptomatic
Medication: —
Clinical Procedure: Carotid artery stenting
Specialty: Cardiology

Objective: Unusual or unexpected effect of treatment

Background: The use of a carotid artery stent (CAS) is a management option for high-risk patients with carotid artery stenosis. An access site for CAS that involves the transcervical approach may be performed percutaneously or may require a cutdown, and usually includes a flow-reversal system to reduce the risk of embolization. Two cases are presented where the transcervical approach to CAS incorporated a distal filter for embolic protection, with a successful outcome.

Case Report: 1. A 78-year-old man with a history of prior irradiation for head and neck cancer presented for CAS after clinical evaluation showed that he was a poor candidate for carotid endarterectomy (CEA). A femoral approach for carotid artery access was not successful due to a tortuous type III aortic arch. A surgical cutdown of the carotid artery was performed with the use of a distal filter, and the CAS was inserted with no embolic events.
2. A 69-year-old man with an anatomically high bifurcation of his carotid artery was not a candidate for CEA due to limited carotid artery access. Diagnostic carotid angiography was also difficult to perform. The CAS was successfully sited with the use of a distal filter and with no post-procedural complications.

Conclusions: CAS is an option for carotid artery stenosis in patients with high surgical risk for CEA. Although a flow-reversal system is usually used to reduce embolic events, these two cases demonstrate that one can also avoid embolism with a distal filter instead.

MeSH Keywords: Carotid Artery Diseases • Carotid Stenosis • Stents

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/912769

2253 — 5 14

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]

Background

Severe but asymptomatic carotid artery stenosis can be managed with carotid endarterectomy (CEA) or carotid artery stenting (CAS). Currently, studies have shown that CEA and CAS have similar long-term outcomes, but periprocedural death and stroke rates are increased with CAS [1,2]. The preferred treatment for patients with asymptomatic carotid artery disease remains controversial, and the management decision is usually made on an individual basis. CAS is less invasive and may offer better outcomes in high-risk surgical patients. Anatomic or clinical limitations such as contralateral carotid stenosis, patients at high risk for general anesthesia and previous cervical irradiation are associated with poor clinical outcome when CEA is performed [3]. In such cases, an endovascular approach using CAS may be preferred.

There are several approaches to obtain access to the stenosed carotid artery. One method is percutaneous access through the common femoral artery, but other approaches include the upper extremity [4], transcervical access [5], and even transradial access [4]. The femoral approach requires imaging before the procedure to assess the anatomy of the aortic arch. It is difficult to guide and manipulate wires and catheters if a patient has a type III aortic arch or has a significant amount of atherosclerosis within the aortic arch. In such cases, the transcervical approach may be preferred, to bypass the tortuous or atherosclerotic aorta.

Transcervical CAS may be percutaneous or involve a small cutdown near the proximal common carotid artery, and can usually be done under general anesthesia. The procedure consists of transcervical occlusion of the proximal common carotid artery and protective shunting by inserting a sheath into the common carotid artery and connecting it to another sheath placed in the ipsilateral internal jugular vein. The common carotid artery is then clamped proximally to the sheath within it, which allows the cross-perfusion pressure to lead to flow reversal from the internal carotid artery to the internal jugular vein. By reversing flow, particulate matter is diverted away from the internal carotid artery, and the risk of embolization is reduced. The reverse flow system usually also uses a filter to remove debris before returning blood to the vein for further embolic protection [6]. When other access approaches are implemented, distal or proximal filter devices are used instead to catch debris as the carotid stent is being sited.

Two unique cases are presented of patients with carotid artery stenosis who were unsuitable for CEA and who underwent transcervical CAS with a modified method that used a distal filter instead of flow reversal. Both patients had a successful clinical outcome with no complications. This case series describes the modified and simplified transcervical CAS procedure used.

Case Report

Case 1

A 78-year-old man presented for elective internal carotid artery stenting for asymptomatic severe subtotal occlusion of the left internal carotid artery (Figure 1). He had a past medical history of coronary artery disease, hypertension, hyperlipidemia, pacemaker implantation for sick sinus syndrome, and a history of radiation to the head and neck for a Merkel cell carcinoma. He had also had previous percutaneous coronary angiography and intervention. Previous angiography had shown a type III aortic arch. The patient was evaluated by vascular surgery and was considered to be a poor candidate for carotid endar- terectomy (CEA) due to a history of head and neck irradiation and a short neck. Percutaneous carotid artery stenting (CAS) was initially attempted with access via the femoral approach. However, this procedure was unsuccessful due to a very tortuous and calcified type III aortic arch (Figure 2).

Carotid artery stenting (CAS) via the transcervical approach was then performed. The patient was given general anesthesia with the head turned towards the right side. The common carotid artery was exposed using surgical cutdown and exploration. A sheath was introduced into the common carotid artery with passage through the skin of the incision proximally to allow for improved stability of the sheath (Figure 3). An arteriovenous shunt was not created between the common carotid artery and the internal jugular vein, and flow reversal was not implemented. Instead, the area of stenosis was identified with a carotid angiogram and was crossed with a filter wire where an RX Accunet Embolic Protection System (Abbott Vascular, Chicago, IL) was used distally in the petrous portion of the left internal carotid artery (Figure 4). The lesion was then predilated with a 3.0×20 mm Rx Viatrac™ balloon catheter (Abbott Vascular, Chicago, IL) followed by the use of a 6–8×30 mm RX Acculink carotid stent (Abbott Vascular, Chicago, IL). Post-dilation was then performed with a 5.0×20 mm Rx Viatrac™ balloon catheter (Abbott Vascular, Chicago, IL), with good results (Figure 5). There was a Thrombolysis in Myocardial Infarction (TIMI) flow grade of 3, with no evidence of carotid artery recoil, dissection, or distal embolization. The filter was retrieved followed by sheath removal. The arteriotomy site was sutured and hemostasis was successfully achieved. The patient tolerated the procedure well and was successfully extubated. He was neurologically intact with National Institutes of Health Stroke Scale (NIHSS) score of zero. Following the procedure, he remained on dual antiplatelet and statin therapy.

Case 2

A 69-year-old man with past medical history of left internal carotid artery stenosis following left carotid endarterectomy (CEA)

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]

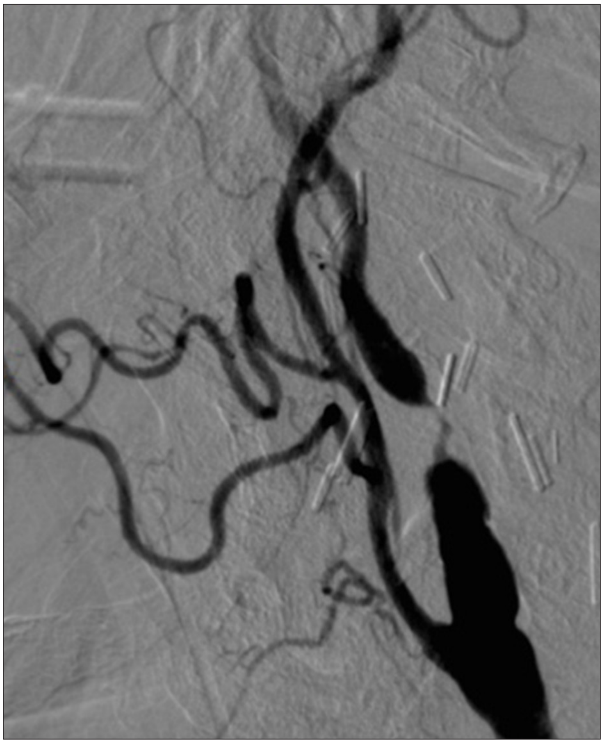

Figure 1. Case 1. Digital subtraction carotid artery angiography. The image shows severe (99%) stenosis of the left internal carotid artery.

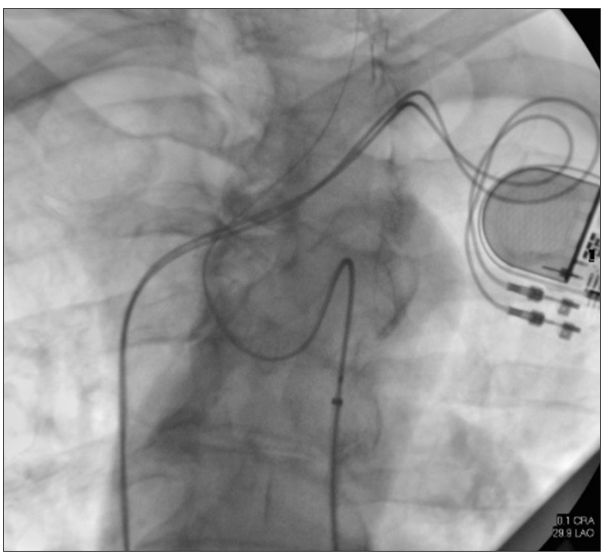

Figure 2. Case 1. An angiogram showing the course of the wire and sheath. The image shows unsuccessful cannulation of the left common carotid artery with the shuttle sheath.

presented for carotid angiography. He had developed progression of right-sided carotid artery disease, which was detected by a carotid artery bruit on physical examination and high blood flow velocities on vascular ultrasound. Severe right internal

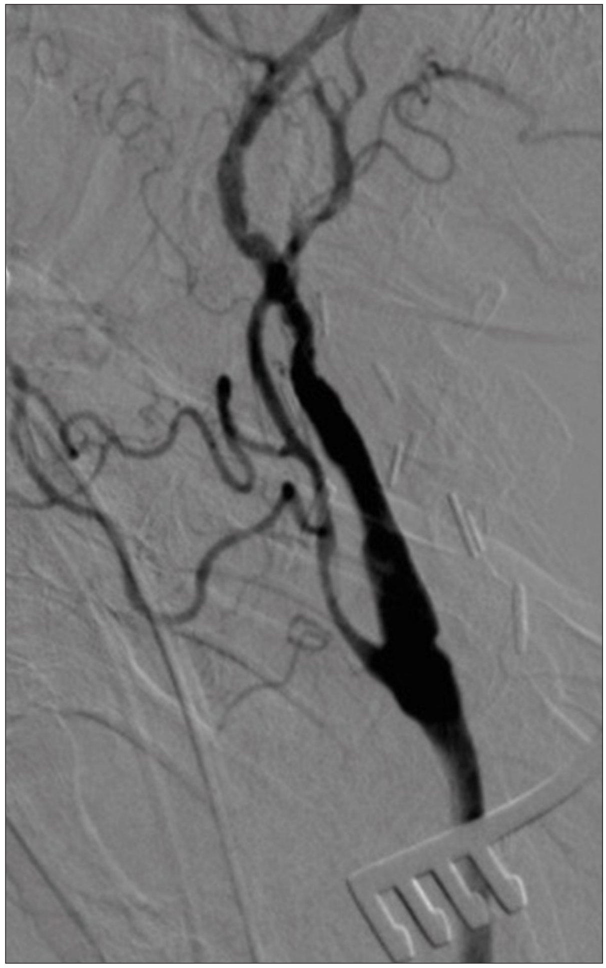

Figure 3. Case 1. Image of insertion of the sheath into the left common carotid artery. A 6-French sheath is shown inserted through the skin into the proximal left common carotid artery.

carotid stenosis was confirmed, and his carotid bulb and carotid artery bifurcation were noted to be high, located behind the mandible, and surgically inaccessible for a CEA procedure. The diagnostic procedure, undertaken via a femoral artery approach, was challenging due to a severely tortuous abdominal aorta and difficulty engaging the right common carotid artery.

Given the above findings, and following discussions involving the vascular surgeon, a decision was made to use the transcervical approach. A carotid artery sheath was introduced proximally into the right common carotid artery, without flow-reversal. A distal embolic filter device was used in the petrous portion of the right internal carotid artery, which was a 7.2 mm Abbott Emboshield NAV6 Embolic Protection System (Abbott Vascular, Chicago, IL). First, the carotid artery lesion was with pre-dilated with a 4.0×20 mm Rx Viatrac™ balloon catheter (Abbott Vascular, Chicago, IL), and then stented with a 7–10×40 mm RX Acculink carotid stent (Abbott

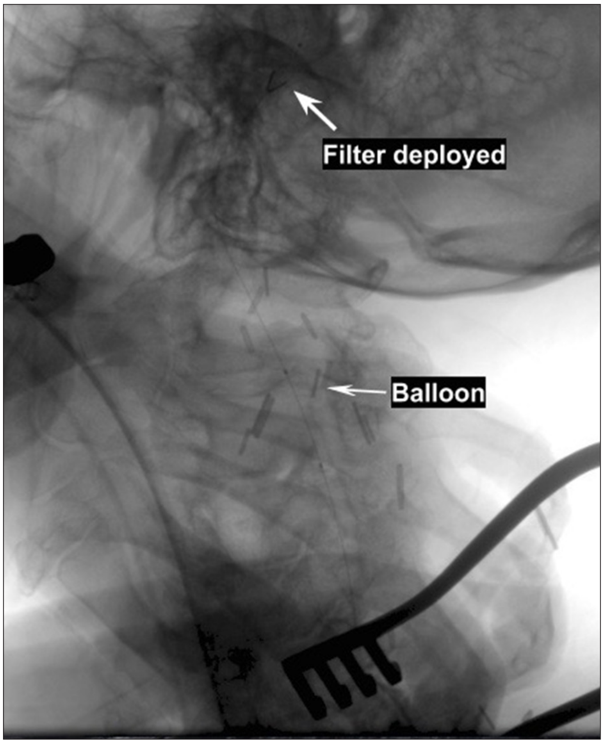

Figure 4. Case 1. Carotid artery angiography shows the position of the balloon and filter. The carotid artery angiographic image shows the wire (arrow) and filter used in the petrous portion of the left internal carotid artery. The balloon (arrow) is ready to inflate.

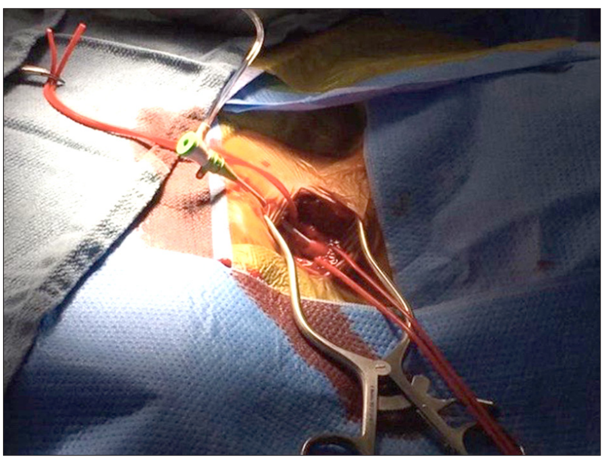

Figure 5. Case 1. Carotid artery angiography of the left internal carotid after stent placement. The carotid artery angiographic image of the left internal carotid artery post stent placement and post-dilation with a Thrombolysis in Myocardial Infarction (TIMI) flow grade of 3. There were no complications.

Vascular, Chicago, IL). Post-dilation was then performed with a 5.0×20 mm Rx Viatrac™ balloon catheter (Abbott Vascular, Chicago, IL). This approach was again successful and normal carotid blood flow was successfully re-established. There were no complications, including no neurological complications, on follow-up. He was discharged home the next day in a stable condition and on optimal medical therapy.

Discussion

The use of the carotid artery stent (CAS) has become the preferred method for the management of asymptomatic severe carotid artery stenosis in patients considered to be at high risk for surgery. Patients who may have a poor outcome following CAS include patients of advanced age, patients with severe cardiopulmonary dysfunction, patients with advanced renal disease, and patients with anatomical changes that may challenge surgical access, or with prior irradiation to the neck [3,7]. Previously published studies have demonstrated the safety of CAS in the elderly, including patients who are more than 80 years of age [5,7].

Conventional stenting procedures used for the carotid artery can be performed using various approaches for access. Most commonly, percutaneous access is achieved through the common femoral arteries. An arch aortogram is usually performed to define the type of aortic arch and help determine the choice of catheters. If there is imaging evidence of significant carotid artery calcification or atherosclerotic disease, this may indicate an increased risk of athero-embolization during the procedure. It is also more difficult to maneuver wires and catheters into an anatomically challenging arch, such as a type III arch, or when there is severe aortic tortuosity. A previously published study has shown increased fluoroscopy time and increased complications in patients who have a type III aortic arch [8]. In these cases, it may be best to proceed with a transcervical approach to reduce the risk of athero-embolization and to improve postoperative outcome. In the first case described (Case 1), the patient had both an anatomically challenging type III aortic arch as well as increased atherosclerotic disease of the aorta. In the second case (Case 2), the tortuosity of the vasculature made it difficult to maneuver wires and catheters near the focal carotid artery lesion. The first patient (Case 1) had a history of previous neck irradiation and had a short neck. The second patient (Case 2) had a very high common carotid bifurcation rendering surgical access for carotid endarterectomy (CEA) inappropriate. Therefore, a transcervical approach using a CAS was the best option for both patients.

The transcervical approach to the carotid artery usually involves creating a shunt, either between the common carotid artery and the internal jugular vein or between the common carotid

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]

artery and the common femoral vein [6]. The common carotid artery is usually clamped proximally, and there is flow reversal from the common carotid artery into the venous system, which requires that the contralateral carotid system is patent and free from significant disease. The flow reversal system usually involves a filter that collects debris before returning the blood to the vein. This flow reversal is necessary to reduce the risk of periprocedural embolic events. By shunting the blood to the lower pressure venous return, micro-emboli are continuously directed away from the brain.

The femoral approach includes the use of a distal embolic filter by first passing through the stenosis while blood flow remains antegrade. A previously published study has shown similar clinical outcomes following the use of both forms of embolic protection devices [9]. In the transcervical method used for both our patients, a surgical cutdown was used to access the common carotid artery and this was followed by the placement of a distal embolic filter with no implementation of flow reversal. Both patients tolerated this procedure well and were discharged home in a stable condition.

Currently, there are several embolic protection devices (EPDs) available for use. Distal filters, as were used in these two cases, are a type of EPD. Typically, distal filters have a small net that is known as a 'basket.' This basket is supported by expandable metal. Longer baskets will allow for better debris capture. Baskets of smaller length can become overfilled with debris and risk loss of debris into the vessel lumen when retrieving the filter. Blood can circulate through the pores of the filter, as the pore sizes are frequently between 100–150 microns. A white blood cell measures 25 microns in diameter, but platelets measure 3–4 microns in diameter. These pores also allow for contrast to pass through for arterial visualization. The filter is attached to a delivery sheath until it is released past the stenosis. Several images need to be taken to ensure the filter is placed in the accurate location, which will reduce the likelihood of debris traveling around the filter. The filters may be difficult to use in very tortuous vessels. The filter can be used for up to ten minutes, but prolonged use of the filter can lead to a slow-flow or no-flow phenomenon, and the filter should be removed with a retrieval sheath when the procedure is completed [10].

There have been no reported studies describing the use of EPDs instead of flow reversal with CAS in approaches other than through the femoral artery. The use of an EPD, instead of flow reversal, in the transcervical approach is likely to be a novel method. There have been previously reported studies that have shown equate embolic protection of flow-reversal when compared with EPD, with the suggestion that this may be a better approach [12]. However, more convincing data exists to support the use of EPDs as a superior method of eliminating distal embolization during CAS, and in preventing neurologic sequelae [13]. Both methods continue to be used as they show similar effects on the elimination of embolization. The downfall of EPDs, as previously described, is that their prolonged use can lead to a slow-flow or no-flow phenomenon. Flow-reversal also has its consequences as it is not tolerated well in 30% of patients since it may lead to cerebral ischemia [14].

Early carotid artery stents were closed-cell stents, which included interconnected stent struts. The open-cell design was then introduced that had larger gaps between the struts. The hybrid-cell design stents consist of proximal and distal segments with an open-cell design in combination with a central closed-cell segment. The advantage of the open-cell or hybrid cell designs is to allow flexibility when used in patients with angulated or tortuous vessels. The results of a previously published study showed no significant difference in adverse event rates, including embolization following CAS, between the closed-cell stent group and the hybrid-cell stent group [11]. However, procedural internal carotid artery vasospasm more frequently occurred in the closed-cell stent group [11].

Conclusions

Transcervical carotid access with the use of a carotid artery stent (CAS) may be necessary for patients who are not suitable candidates for carotid endarterectomy (CEA). Typically, the method involves flow reversal of the carotid artery into a venous system. In the two cases presented in this report, the method for the CAS procedure differed in that the flow was antegrade and a distal embolic filter was used, which is more commonly associated with the percutaneous femoral access approach. Further studies are needed to test the efficacy and risks associated with this technique.

References:

1. Bonati LH, Dobson J, Featherstone RL et al., International Carotid Stenting Study investigators: Long-term outcomes after stenting versus endarterectomy for treatment of symptomatic carotid stenosis: The International Carotid Stenting Study (ICSS) randomised trial. Lancet, 2015; 385(9967): 529–38
2. Bonati LH, Lyrer P, Ederle J et al: Percutaneous transluminal balloon angioplasty and stenting for carotid artery stenosis. Cochrane Database Syst Rev, 2012; (9): CD000515
3. Wimmer NJ, Yeh RW, Cutlip DE, Mauri L: Risk prediction for adverse events after carotid artery stenting in higher surgical risk patients. Stroke, 2012; 43(12): 3218–24
4. Fang HY, Chung SY, Sun CK et al: Transradial and transbrachial arterial approach for simultaneous carotid angiographic examination and stenting using catheter looping and retrograde engagement technique. Ann Vasc Surg, 2010; 24(5): 670–79

5. Alvarez B, Matas M, Ribo M et al: Transcervical carotid stenting with flow reversal is a safe technique for high-risk patients older than 70 years. J Vasc Surg, 2012; 55(4): 978–84
6. Criado E, Doblas M, Fontcuberta J et al: Transcervical carotid artery angioplasty and stenting with carotid flow reversal: Surgical technique. Ann Vasc Surg, 2004; 18(2): 257–61
7. Nanto M, Goto Y, Yamamoto H et al: Periprocedural outcomes of carotid artery stenting in elderly patients. J Stroke Cerebrovasc Dis, 2018; 27(1): 103–7
8. Dorresteijn LD, Vogels OJ, de Leeuw FE et al: Outcome of carotid artery stenting for radiation-induced stenosis. Int J Radiat Oncol Biol Phys, 2010; 77(5): 1386–90
9. Madhwal S, Rajagopal V, Bhatt DL et al: Predictors of difficult carotid stenting as determined by aortic arch angiography. J Invasive Cardiol, 2008; 20(5): 200–4
10. Kasirajan K, Schneider PA, Kent KC: Filter devices for cerebral protection during carotid angioplasty and stenting. J Endovasc Ther, 2003; 10(6): 1039–45
11. Tatli E, Tokatli A, Vatan MB et al: Comparison of closed-cell and hybrid-cell stent designs in carotid artery stenting: Clinical and procedural outcomes. Postepy Kardiol Interwencyjnej, 2017; 13(2): 135–41
12. Criado E, Fontcuberta J, Orgaz A et al: Transcervical carotid stenting with carotid artery flow reversal: 3-year follow-up of 103 stents. J Vasc Surg, 2007; 46(5): 864–69
13. Castro-Afonso LH, Abud LG, Rolo JG et al: Flow reversal versus filter protection: A pilot carotid artery stenting randomized trial. Circ Cardiovasc Interv, 2013; 6(5): 552–59
14. Giugliano G, Stabile E, Biamino G et al: Predictors of carotid occlusion intolerance during proximal protected carotid artery stenting. JACC Cardiovasc Interv, 2014; 7(11): 1237–44

Indexed in: [PMC] [PubMed] [Emerging Sources Citation Index (ESCI)] [Web of Science by Clarivate]