Clinical Trial

Clin Ter 2020; 171 (1):e30-35. doi: 10.7417/CT.2020.2185

A new method for left carotid angiography: use right judkins 4 guiding (6f) catheter with 2 side holes

Hakan Gocer[1], Gökhan Keskin[2], Murat Gunday[3], Mustafa Unal[4]

[1]İzmir Medicalpark Hospital, Cardiology, İzmir, Turkey; [2]Amasya Medical School, Cardiology, Amasya, Turkey; [3]Afyon Health Sciences University, Cardiovascular Surgery, Afyonkarahisar, Turkey; [4]Bicard Clinic, Cardiovascular Surgery, Bishkek, Kyrgyzstan

Abstract

Objective. To introduce a rapid and simple technique to engage and localize through left common carotid (LCCA) artery during selective carotid angiography using the same type of catheter (6F Medtronic™/launcher Judkins Right Guide Catheter, 4.0 Tip,2 Side holes, U.S.A.)

Methods. Patients were divided into two groups as new method and conventional method group including 295 and 292 prior to carotid angiography, respectively. The primary endpoints of this study included an analysis of total procedure time, time required for cannulation of left common carotid artery, fluoroscopy time and selective imaging success for left common carotid artery, feasibility, safety, amount of radio opaque agent and radiation exposure.

Results. Our novel method applied using a single catheter shortened total procedure time (5.41 ± 1.56 min. vs. 7.52 ± 2.48 min., respectively, p<0.001), fluoroscopy time (98 ± 9 sec. vs. 210 ± 19 sec., respectively, p<0.001), duration of left carotid artery cannulation (15 ± 1.2 sec vs. 42 ± 1.9 sec, respectively, p < 0.001). Use of our method reduced radiation exposure (120 ± 17 mGy vs. 217 ± 11 mGy, respectively, p<0.001), amount of contrast agent (44.99 ± 12.84 ml vs. 59.89 ± 18.93 ml, respectively, p<0.001). Aortic arch angiography was not needed in the first group compared with the conventional method group (0% vs. 29%, respectively, p<0.001). Also a higher success was achieved in cannulation of left common carotid artery using an identical catheter compared with application of conventional methods requiring use of different types of catheter (100% vs. 60%, respectively, p<0.001). No major complication and mortality was found due to use of both methods. However, a statistically insignificant elevation in minor complication was encountered in the patient group who underwent coronary angiography by the conventional method (3% vs. 7%, respectively, p<0.064).

Conclusion. This new method is more easily applicable with a shorter duration for cannulation and localization of LCCA, safer for the patients with use of a limited amount of radio-opaque agent and finally cost-effective by requiring only one type of catheter and a limited. ***Clin Ter 2020; 171(1):e30-35. doi:10.7417/CT.2020.2185***

Key words: *Carotid, Angiography, Judkins*

Introduction

There are a wide range of available catheters, wires and sheaths for carotid angiography. Age and vascular anatomy (a cross-sectional imaging prior to angiography may be useful) of the patient, injection rates and compatibility between lengths and widths) should be considered in selection of catheter. Cervical arch arteriogram (CAA) is useful if there is a complication in the origins of the great vessels, an initial reference image is performed due to complex aortic arch anatomy or treatment of a proximal major vessel is targeted. For CAA, selected catheter is a multi-side-holed flush catheter. A 90-cm-long catheter is preferred to reach the aortic arch in most patients. These catheters may prolong procedure time and may increase level of radiation exposure and amount of radio-opaque agent. (4, 5, 6)

The anatomy of aortic arch may be helpful in selection of the catheter for catheterization(s) of major vessels. (7,8) The classification of aortic arch is based on the origin of the major vessel in reference to the curvature of the aortic arch in the cranial-caudal dimension. You can see its illustration in the article entitle "Carotid Artery Stenting: Review of Technique and Update of Recent Literature". Usually, as the great vessel origin migrates caudally, the degree of difficulty increases, especially for interventions that require larger sheaths. Type I and II arch configurations can be routinely catheterized with an angled catheter, while a reverse curve catheter is generally necessary to select vessels arising from Type III arches. (9, 10), (Figure 1).

We have experienced some difficulties in the process of cannulating carotid arteries, especially left common carotid artery while engaging carotid arteries, especially common left carotid artery. We have experienced some difficulties in trying to engage the left carotid artery ostium. The failed attempts of left carotid artery access should be minimized especially if renal insufficiency or excessive radiation exposure is expected. Access to the right brachiocephalic artery is

Abbreviations

CFA: Common femoral artery; **DSA:** Digital Subtraction Angiography; **CAA:** Cervical arch arteriogram; **CT:** Computed tomography; **CCA:** Common carotid artery; **LCCA:** Left common carotid artery; 6F: Six French.

Correspondence: Hakan Gocer, Medical Park Hospital Cardiology Department, İzmir, Turkey. E-mail: drhakangocer@gmail.com

ISSN 1972-6007

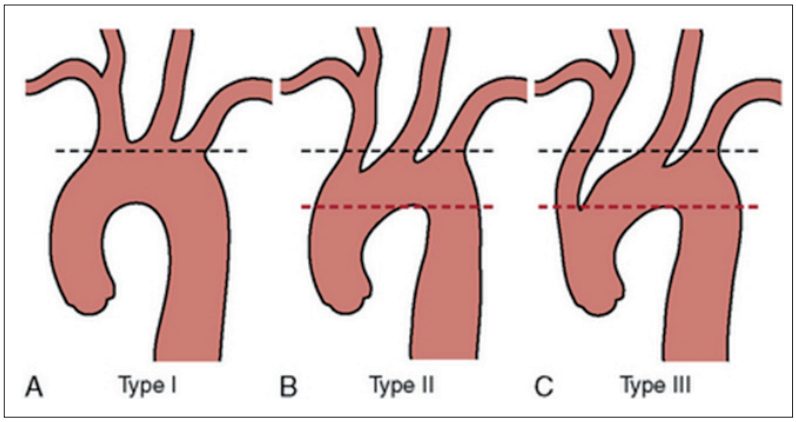

Fig. 1. Types of aortic arches.

usually simple. However, cannulation of left common carotid artery is a very challenging and time-consuming, especially in Type II and III aortic arches. Some operators prefer to use different type of catheters or aortic arch angiography for definition of ostium of left common carotid artery. These techniques may require a long duration of process and use of radio-opaque agent. (7, 8, 9, 10) The objective of this method we have described in this paper is to facilitate cannulation and localization of left common carotid artery with an identical catheter (JR4 Guiding SH) which was used to cannulate right common carotid artery in many procedures as well as coronary angiography.

Methods

This study was performed in Bicard clinic in Bishkek/ Kyrgyzstan, Afyon Health Sciences University, Faculty of Medicine and Izmir Medical Hospital in Turkey and Bicard Clinic in Kirghizistan between the years 2016 to 2018. The study was conducted according to the latest version of Helsinki Declaration. This study included 587 patients with Type II and III aortic arch these patients were selected based on CT scan results (Table 1). Some of the patients were evaluated by only carotid angiography while most of the patients underwent carotid and coronary angiography concomitantly. The control group included randomly selected 292 patients and these patients underwent carotid angiography using conventional methods and different catheters. Davies, Berenstain, Headhunter, VTK or Simmons catheters can be used in this procedure. In engagement of carotid ostium, the catheter can be advanced over a 0.035-inch guide wire. Injection of diluted low-osmolar contrast agent is typically performed with digital subtraction at 4 to 6 ml/second for a total of 8 ml in common carotid artery with DSA at four or six frames/ second. (1, 2, 3) Carotid angiography was performed with a novel method by an identical experienced interventionist in the remaining 295 patients. The primary endpoints of this study included an analysis of procedure time. The procedure was initiated with local anesthesia for sheath insertion and continued until imaging was complete. Another primary endpoints were time required for cannulation of left common carotid artery as an time interval between right common carotid artery angiography and cannulation of left common carotid artery following, fluoroscopy time and selective imaging success of left and right common carotid artery. If carotid and coronary angiography were performed concomitantly, carotid angiography is primarily performed and only time required for carotid angiography could be evaluated. In this study, feasibility, safety, and imaging success rates, amount of radio-opaque agent and durations of procedure were measured and statistically compared.

We prefer right common femoral artery (CFA) for access to aortic arch and carotid arteries, similar to coronary angiography. A 6 F sheath introducer was placed in CFA. Following, Guide wire (0,038) and JR4-SH guiding catheter were advanced through the aortic arch towards aortic valve. The cannulation of right brachiocephalic artery was usually accomplished via withdrawal and clockwise rotation of catheter while small amount of contrast was injected with hand injectors in the level of aortic arch. This part of angiography is usually easy for the interventionist. However, many difficulties may be experienced if same type of catheter is used in engagement of left common carotid artery through a different type of aortic arch.

Actually, this part of carotid angiography is the hardest and the most time-consuming part of the procedure. Even if you are an experienced operator, you may experience many difficulties especially in using different type of aortic arches (Type 2-3). In addition, total procedure time, level of radiation exposure, amount of contrast agent and complication rates could be consequently reduced if this part of the procedure can be shortened. Cannulation of left common carotid artery can be performed by applying different catheters and methods. However, operators can use the same catheter for both left and right carotid angiography in application of our method. There is no need to replace the catheter. The Judkins right coronary guiding catheter is sized according to the length of the secondary curve and in 3.5, 4 or 5-cm in width. The 4-cm catheter is usually adequate for the most cases. In our method, we have used six French (6F) Judkins right coronary guiding catheter with two side holes in our method.

Under this condition, you can use this method as a rescuer. After obtaining right CCA angiography with JR4-SH guiding, you withdraw the catheter towards the ostium of the right brachiocephalic artery, you have to stay at the edge of the ostium without disengaging ostium. In another saying, tip of JR4-guiding SH catheter should be located near the ostium of the brachiocephalic ostium. At that position, side holes of the JR4-guiding SH catheter are located in aortic arch nearby the ostium of the left common carotid artery. This may allow you to access the ostium of left common carotid artery via side holes of the catheter (Figure 2). You can use this position of JR4-guiding SH catheter in two ways. One of those ways is to localize ostium of the left common carotid artery using a little amount of contrast agent injection. If you intend to engage the left common carotid artery selectively for angiography, interventionist or diagnostic purposes after locating ostium of the left carotid

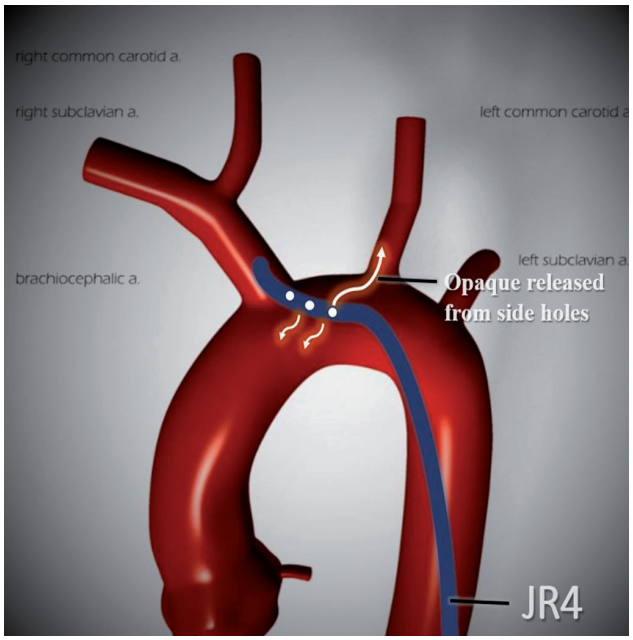

Fig. 2. JR4 (Judkins Right) Guiding catheter with side holes, visualization and localization of left carotid artery using new method.

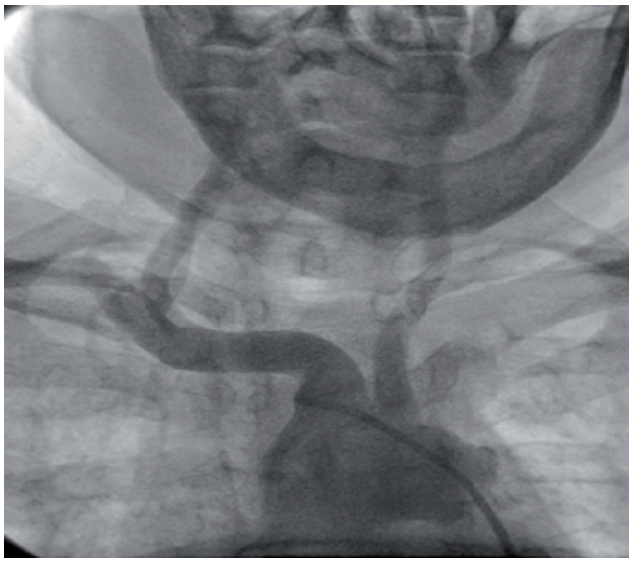

Fig. 3. Angiographic images of the left carotid artery and its ostium obtained through side holes of (6F, JR4) guiding catheter.

Table 1. Baseline characteristics of participants.

	New method for carotid artery angiography N=295	Conventional methods for carotid artery angiography N=292	P = Value
Sex, male, n (%)	155 (52.6)	153 (52.4)	P = 0.98
Age (years)	66.36± 9.47	65.81 ± 9.33	P = 0.56
Prior stroke or TIA	78 ±3.12	102 ±3.18	P = 0.89
Hemoglobin (g/dl)	14 ± 3.0	12 ± 2.2	P = 0.83
Haematocrit %	39 ± 5.3	36 ± 5.2	P = 0.92
Fasting glucose (mg/dl)	99 ± 20	101 ± 28	P = 0.92
Total cholesterol, mg/dl	211 ± 40	209 ± 38	P = 0.93
Uric acid, mg/dl	4.3 ± 1.3	9.2 ± 1.1	P = 0.03
BUN, mg/dl	13 ± 0.8	12 ± 0.6	P = 0.68
Creatinine, mg/dl	0.8 ± 0.5	0.8 ± 0.4	P = 0.96
Type 2 aortic arch, n, (%)	137 (46.5)	142 (48.6)	P = 0.93
Type 3 aortic arch, n, (%)	158 (53.5)	150 (51.4)	P = 0.91
Concomitant Coronary Angiography, n, (%)	178(60.4)	180(61.6)	P=0.87
Major complication (Death TIA, Stroke, major haemorrhage, renal failure, i.e.), n, (%)	0(0%)	0(0%)	_
Minor complication (hematoma, minor bleeding, rise of renal function tests) n, (%)	9(3%)	23(7%)	P=0.064

artery, you can attempt to engage it separately. The other way is to carotid angiography for both carotid arteries with power ejector injections concomitantly which is typically accomplished with injection of 40 mL contrast agent at the rate of 20 mL/s in 2 seconds while catheter is seated in the ostium of the right brachiocephalic artery (Figure 3).

We applied this new method in 295 times patients with Type II and III aortic arches and while performing via conventional methods in the other 292 patients during selective carotid angiography. The results in these two groups were compared statistically.

Statistical Analysis

The statistical package SPSS (Statistical Package for the Social Sciences, version 17.0, SSPS Inc, Chicago, Ill, USA) software was used for statistical analysis. Continuous variables were expressed as mean± standard deviation. Categorical variables were expressed as total number (percentage). All continuous variables were evaluated with the Kolmogorov–Smirnov normality test to show distributions. Continuous variables with normal distributions were compared using the unpaired Student *t*-test and ANOVA

with the Tukey's post-hoc test. Continuous variables with abnormal distributions were compared applying the Mann–Whitney *U* test and ANOVA with the Tukey's post-hoc test. the Chi-square test was used for comparison between the categorical variables. The value p<0.05 was accepted as the level of significance in the tests.

Results

Baseline demographic, clinical and laboratory results of the all patients were presented in Table 1. All patients underwent carotid angiography. However, some of them were evaluated by both carotid and coronary angiography. There was no statistically significant difference in terms of the parameters except uric acid level which was found higher in the conventional method group (4.3 ± 1.3 mg/dl vs. 9.2 ± 1.1 mg/dl, respectively, P=0.03) The application of our novel method shortened total procedure time compared with the conventional method (5.41 ± 1.56 min. vs. 7.52 ± 2.48 min., respectively, p<0.001) and cannulation duration of left carotid artery cannulation (15 ± 1.2 sec vs. 42 ± 1.9 sec, respectively, p<0.001). Also amount of the contrast agent (44.99 ± 12.84 ml vs. 59.89 ± 18.93 ml, respectively, p< 0.001) and level of radiation exposure (120 ± 17mGy, 217 ± 11 mGy, respectively, p< 0.001) were significantly lower in the new method group compared than conventional group (Table 2). We used a single type of catheter to cannulate right and left carotid artery concomitantly. Therefore, cannulation duration of left common carotid artery was shorter (New method: 15 ± 1.2 sec, conventional method: 42 ± 1.9 sec, respectively, p< 0.001) while need for aortic arch angiography (New method 0%, conventional method: 29%, respectively, p< 0.001) was lower by application of the new method than control group. Also a higher success rate was achieved by use of a single catheter (100% vs. 60%, respectively, p< 0.001) than use of conventional method which requires use of different types of catheters. Consequently, a shorter fluoroscopy duration was needed with novel method (New method: 98 ± 9 sec, 210 ± 19 sec, respectively, p< 0.001). No major complication and no mortality occurred in both groups (Table 2) However, a statistically insignificant elevation found in minor complications in the conventional method group (New method: 3%, conventional method: 7%, p=0.064). Incidents of hematoma at the access site were respectively 3 and 10 in the new and conventional groups while slightly increased blood creatinine and BUN levels were found in 3 and 12 patients in the new and conventional method groups, respectively. Besides, allergic reaction against radio-opaque contrast agent developed in 3 patients in the conventional method group.

Discussion

We have demonstrated in our study that this novel method performed using a single catheter (JR4-SH) is more effective than conventional methods performed using different catheters in terms of reducing total procedure time (p<0.001), radiation exposure (p< 0.001), fluoroscopy time (p < 0.001) and amount of the administered contrast agent (p< 0.001). Also, cannulation duration of left carotid artery was significantly lower than that of conventional method (p< 0.001). Besides, application of this new method makes aortic arch angiography unnecessarily although it is commonly used to cannulate and localize carotid arteries in procedure of conventional methods (p<0.001) while cannulation success of left common carotid artery with a single catheter is extremely higher than conventional methods (p<0.001). Although there was no difference between the groups in terms of major complications and mortality. However, a statistically insignificant elevation found in minor complications in the conventional method group (p=0.064). Some of the patients were evaluated with coronary angiography for coronary atherosclerosis in both groups and there was no statistically significant difference between the groups in terms of this parameter (p= 0.87).

We are pretty experienced in the field of engagement of different arteries as an interventionist cardiologist. We have achieved this level of experience thanks to numerous interventions and diagnostic approaches. (17,18) and this experience allows us to develop some practical approaches in problem solving. Furthermore, coronary atherosclerosis is associated with cerebral and carotid atherosclerosis in most of the cases. Application of coronary atherosclerosis concomitantly with coronary artery angiography is an advantageous opportunity for the patient. (13,14,15) Thus, we have performed many carotid angiographies as an interventionist cardiologist. The parameters such as procedure time, meticulous manipulation and use of minimal invasive techniques, lower amount of contrast agent and lower radiation exposure are very crucial especially in the patients with concurrent indications for carotid angiography. There are also some conflicts between radiologists and cardiologists about application of this kind of procedures. Interventionist radiologists have applied a wide variety of techniques using several catheters in engagement of carotid arteries as we have mentioned before. Replacing catheters and performing aortic arch angiography to localize carotid ostium are predominantly performed by interventionist radiologists and non-experienced cardiologists. As a consequence of this selection, procedure time, radiation exposure and amount of the contrast agent increased. On the other hand, interventional cardiologists became accustomed to use coronary catheters in many diagnostic and interventional procedures. We find this preference to be practical, cost effective and time saving.(18) In our methods, we use JR4-SH as a single type of catheter in performing both right coronary and carotid angiographies concomitantly at one session or only carotid angiography. As a consequence of this situation, there was no need for using other catheter and performing aortic arch angiography.

You can perform carotid angiography via cannulation of carotid arteries selectively which yields more accurate images than non-selective angiography. As a matter of fact, selective cannulation and localization of the left common carotid artery are hardest aspect of carotid angiography especially in the patients with Type II and III aortic arches. Our method suggests an easy way of cannulation and localization of left carotid artery. You can also perform carotid angiography non-selectively in our method (Figure 3). Furthermore, our method provides reduced procedure

Table 2. Catheter based results.

	New Method for carotid artery angiography	Conventional methods for carotid artery Angiography	P value
Total procedure time (minute)	5.41 ± 1.56	7.52 ± 2.48	P < 0.001
Contrast amount [ml]	44.99 ± 12.84	59.89 ± 18.93	p < 0.001
Radiation exposure- Total air kerma [mGy]	120 ± 17	217 ± 11	p < 0.001
Major-minor complication or Death	0	0	_
Left Carotid artery Cannulation time (second)	15 ± 1.2	42 ± 1.9	p < 0.001
Cannulation success of left common carotid artery with same catheter	95%	60%	p < 0.001
Aortic arch angiography	0%	29%	p < 0.001
Fluoroscopy time (second)	98 ± 9	210 ±1 9	p < 0.001

time, radiation exposure, amount of contrast agent and less manipulation of catheters which is especially important in the critically ill patients. It has been shown that there is a slight and statistically insignificantly elevated minor complications. This elevation is associated with excess amount of radio-opaque media pointing out the importance of shortening procedure time that can be easily achieved by applying our one-catheter method.

If the operator is inexperienced in localization and selective cannulation of carotid artery concomitantly with coronary angiography in catheter laboratory which suffers from shortage of various catheters, it would be advisable to prefer our method which is cost effective, safe and rapidly applicable with an convenient way to localize LCCA and to complete bilateral carotid angiography especially in patients with Type II and type III aortic arches. If you are performing carotid angiography concurrently with coronary angiography, you will not need an extra catheter for bilateral selective and non-selective carotid angiography. This method is a very practical and rapidly applicable method which shortens procedure time even it is performed by the inexperienced operators.

We have demonstrated in our study that it is an easy, practical, time-saving, simple and safe method when you attempt for localization or selectively cannulation of the left common carotid artery during carotid angiography. This novel method we have described above is a convenient and cost-effective method.

Conclusion

This new method for carotid angiography using one catheter (JR4,SH) is a practical, time saving, cost effective method which reduces exposure level to radiation and radio-opaque material. Also angiography team is exposed to less radiation thanks to this method. This method is easy to apply and requires one type of catheter and administration of a limited amount of radio-opaque media as well as reducing time for localization and cannulation of LCCA obtaining carotid angiography especially in the patients with different type aortic arches.

References

1. ACR Committee on Drugs and Contrast Media . Media, A.C.o.D.a.C., ACR Manual on Contrast Media Version 8, 2012.
2. Barrett B J, Katzberg R W, Thomsen H S. et al. Contrast-induced nephropathy in patients with chronic kidney disease undergoing computed tomography: a double-blind comparison of iodixanol and iopamidol. Invest Radiol. 2006;41(11):815–821.
3. Ahn S H, Prince E, Dubel G. Carotid artery stenting: review of technique and update of recent literature. Semin Intervent Radiol. 2013;30(3):288–296.
4. Hui FK, Yim J, Spiotta AM, et al. Intermediate catheter injections in closed segments during acute stroke intervention: a cautionary note. J Neurointerv Surg. 2012;4(6):e39.
5. Khatri R, Khatri P, Khoury J, Broderick J, Carrozzella J, Tomsick T. Microcatheter contrast injections during intra-arterial thrombolysis increase intracranial hemorrhage risk. J Neurointerv Surg. 2010;2(2):115–119.
6. Citron S J, Wallace R C, Lewis C A. et al. Society of Interventional Radiology; American Society of Interventional and Therapeutic Neuroradiology; American Society of Neuroradiology . Quality improvement guidelines for adult diagnostic neuroangiography. Cooperative study between ASITN, ASNR, and SIR. J Vasc Interv Radiol. 2003;14(9, Pt 2):S257–S262.
7. Thiex R, Norbash A M, Frerichs K U. The safety of dedicated-team catheter-based diagnostic cerebral angiography in the era of advanced noninvasive imaging. AJNR Am J Neuroradiol. 2010;31(2):230–234.
8. Huapaya JA, Trujillo KC, Trelles M, et al. Anatomic variations of the branches of the aortic arch in a Peruvian population. Medwave. 2015;15:e6194.
9. Ergun E, Simsek B, Kosar P, et al. Anatomical variations in branching patterns of arcus aorta: 64-slice CTA appearance. Surg Radiol Anat. 2014;36:1105–1106.
10. Sciahbasi A, Frigoli E, Sarandrea A, et al. Radiation exposure and vascular access in acute Coronary syndromes: the RAD-Matrix trial. J Am Coll Cardiol. 2017;69:2530–2537.
11. Benjamin EJ, Blaha MJ, Chiuve SE, et al. on behalf of the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke

statistics—2017 update: a report from the American Heart Association. Circulation. 2017;135:e229-e445.
12. Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018.
13. Flaherty ML, Kissela B, Khoury JC, et al. Carotid artery stenosis as a cause of stroke. Neuroepidemiology 2013; 40: 36–41.
14. Seo WK, Yong HS, Koh SB, et al. Correlation of coronary artery atherosclerosis with atherosclerosis of the intracranial cerebral artery and the extracranial carotid artery. Eur Neurol. 2008;59:292–298.
15. Paraskevas KI, Kalmykov EL, Naylor AR Stroke/Death rates following carotid artery stenting and carotid endarterectomy in contemporary administrative dataset registries: a systematic review. Eur J Vasc Endovasc Surg. 2016;51:3–12.
16. Lombardo A, Biasucci LM, Lanza GA, et al. Inflammation as a possible link between coronary and carotid plaque instability. Circulation 2004; 109: 3158–3163
17. Patel T, Shah S, Ranjan A, et al. Contralateral transradial approach for carotid artery stenting: a feasibility study. Catheter Cardiovasc Interv. 2010; 75:268–275
18. Yousem D M, Trinh B C. Injection rates for neuroangiography: results of a survey. AJNR Am J Neuroradiol. 2001;22(10):1838–1840