Suggested standards for reporting on arterial aneurysms

Prepared by the Subcommittee on Reporting Standards for Arterial Aneurysms, Ad Hoc Committee on Reporting Standards, Society for Vascular Surgery and North American Chapter, International Society for Cardiovascular Surgery.
K. Wayne Johnston, MD (Chairman, Arterial Aneurysms Subcommittee);
Robert B. Rutherford, MD (Chairman, Ad Hoc Committee); M. David Tilson, MD, Dhiraj M. Shah, MD, Larry Hollier, MD, and James C. Stanley, MD.

The literature on arterial aneurysms is subject to potential misinterpretation because of inconsistencies in reporting standards. The joint councils of the Society for Vascular Surgery and the North American Chapter of the International Society for Cardiovascular Surgery appointed an ad hoc committee to address this issue. This communication, prepared in response to the need for standardized reporting, defines and classifies arterial aneurysms and recommends standards for describing the causes, manifestations, treatment, and outcome criteria that are important when publishing data on aneurysmal disease. (J VASC SURG 1991;13:444-50.)

Published reports on arterial aneurysms are often difficult to interpret or compare because of differences in terminology and criteria for evaluating results. The purpose of this report is to define and classify arterial aneurysms and to suggest standards that can be used as guidelines for reporting the causes, risk factors, anatomic pathologic features, operative details, and outcome criteria that are relevant in reporting on aneurysms.

These guidelines are not meant to be instructions for authors, but rather to provide a detailed outline and classifications of topics that should be considered in a specific report on aneurysms. Precise nomenclature is desirable, but a risk of overclassification exists that may result in such small patient subgroups that meaningful data analysis becomes difficult. Portions of the proposed standards for reporting aneurysms are arbitrary, and as such they may require revision in the future.

DEFINITIONS

The following definition of an arterial aneurysm is suggested: An *aneurysm* is a permanent localized (i.e., focal) dilation of an artery having at least a 50% increase in diameter compared to the expected normal diameter of the artery in question. In this regard normal arterial diameters determined from selected data in the literature should be considered when reporting on aneurysms (Table I). It is apparent that normal values are dependent on the method of measurement and the patient's age, sex, blood pressure, and other factors. Data regarding normal diameters are sparse, and for certain arteries are unavailable. Given the assumption that the arterial diameter proximal to a dilation is normal, by common convention an increase in diameter greater than 50% has been considered evidence of an aneurysm.

Arteriomegaly is diffuse arterial enlargement involving several arterial segments, (i.e., nonfocal) with increase in diameter of greater than 50% by comparison to the expected normal diameter. *Ectasia* is characterized by dilation less than 50% of the normal arterial diameter.

CLASSIFICATION

No classification of arterial aneurysms based on a single factor has proved to be entirely satisfactory. It is therefore recommended that aneurysms be classified with a combination of the following factors: (1) site, (2) origin, (3) histologic features, and (4) clinicopathologic manifestations. In any one specific

Reprint requests: K. Wayne Johnston, MD, Toronto General Hospital, Eaton Building North, 9-217, 200 Elizabeth St., Toronto, Ontario, Canada, M5G 2C4.
24/1/26737

Table I. Representative diameters of normal adult arteries

Vessel	Range of reported mean (cm)	Range of reported standard deviation (cm)	Sex	Assessment method
Thoracic aorta, root	3.50-3.72	0.38	Female	Computed tomography[1]
	3.63-3.91	0.38	Male	Computed tomography[1]
Thoracic aorta, ascending	2.86	–	Female, male	Chest radiograph[2]
Thoracic aorta, mid-descending	2.45-2.64	0.31	Female	Computed tomography[1]
	2.39-2.98	0.31	Male	Computed tomography[1]
Thoracic aorta, diaphragmatic	2.40-2.44	0.27-0.32	Female	Computed tomography[1]
	2.43-2.69	0.27-0.40	Male	Computed tomography,[1] intravenous arteriography[3]
Abdominal aorta, supraceliac	2.10-2.31	0.27	Female	Computed tomography[4]
	2.50-2.72	0.24-0.35	Male	Computed tomography[4]
Abdominal aorta, suprarenal	1.86-1.88	0.09-0.21	Female	Computed tomography[5]
	1.98-2.27	0.19-0.23	Male	Computed tomography[5]
Abdominal aorta, infrarenal	1.66-2.16	0.22-0.32	Female	Computed tomography,[4] intravenous arteriography[3]
	1.99-2.39	0.30-0.39	Male	Computed tomography,[4] intravenous arteriography[3]
Abdominal aorta, infrarenal	1.19-1.87	0.09-0.34	Female	B-mode ultrasound,[7] computed tomography,[4,5] intravenous arteriography[3]
	1.41-2.05	0.04-0.37	Male	B-mode ultrasound,[7-9] computed tomography,[4,5] intravenous arteriography[3]
Celiac	0.53	0.03	Female, male	B-mode ultrasound[10]
Superior mesenteric	0.63	0.04	Female, male	B-mode ultrasound[10]
Iliac, common	0.97-1.02	0.15-0.19	Female	Computed tomography[4]
	1.17-1.23	0.20	Male	Computed tomography[4]
Iliac, internal	0.54	0.15	Female, male	Arteriography[6]
Femoral, common	0.78-0.85	0.07-0.11	Female	Computed tomography,[4] B-mode ultrasound[11]
	0.78-1.12	0.09-0.30	Male	Computed tomography,[4] B-mode ultrasound,[11,12] M-mode ultrasound[13,14]
Popliteal	0.90	0.20	Male	B-mode ultrasound[12]
Tibial, posterior	0.30	0.01	Male	M-mode ultrasound[13]
Carotid, common	0.77	0.08	Female	Arteriography[15]
	0.63-0.84	0.10-0.14	Male	Arteriography,[15] M-mode ultrasound[16]
Carotid, bulb	0.92	0.10	Female	Arteriography[15]
	0.99	0.10	Male	Arteriography[15]
Carotid, internal	0.49	0.07	Female	Arteriography[15]
	0.55	0.06	Male	Arteriography[15]
Brachial	0.39	0.04	Female	M-mode ultrasound[17]
	0.42-0.44	0.01-0.04	Male	M-mode ultrasound[17-19]

report it may be appropriate to select only one of these factors as the basis for classification.

Site

Classification by anatomic segment is important, in that aneurysms located in different sites may be associated with variations in their natural history, clinical presentation, and means of treatment (Table II).

Etiology

An etiologic classification of arterial aneurysms that categorizes factors affecting the arterial wall integrity is important when reporting on these lesions (Table III). Specific comments are warranted regarding certain etiologic factors.

Nonspecific aneurysms, commonly referred to as arteriosclerotic aneurysms, are the most common arterial aneurysms. It is recognized that the exact origin of this type of aneurysm remains to be elucidated. Poststenotic aneurysms are caused by poorly understood hemodynamic factors produced by a hemodynamically significant intrinsic stenosis or external compression of the artery. Most, but not all, anastomotic and traumatic aneurysms are false aneurysms since their walls do not contain all three layers of the arterial wall. Aneurysms may develop as the result of an arterial dissection. Although dissections represent a separate pathologic entity, they are not a distinct etiologic class since they may be associated with Marfan's syndrome, cystic medial necrosis, Ehlers-Danlos syndrome, pregnancy, hypertension,

Table II. Classification of peripheral arterial aneurysms by anatomic site

Aorta
Ascending thoracic
Arch
Descending thoracic
Thoracoabdominal
With splanchnic or renal arterial involvement
Without splanchnic or renal involvement
Abdominal
Suprarenal
Splanchnic and renal arterial involvement
Only renal arterial involvement
Juxtarenal or pararenal (no normal aorta between upper extent of the aneurysm and renal arteries)
Infrarenal
Iliac
Common
External
Internal
Renal
Splanchnic
Splenic
Hepatic
Superior mesenteric
Celiac
Pancreatic, pancreaticoduodenal,
Gastroduodenal, gastric, gastroepiploic
Jejeunal, ileal, colic
Lower extremity
Femoral
Popliteal
Tibial, peroneal, pedal
Extracranial cerebrovascular
Innominate
Carotid
Vertebral
Upper extremity
Subclavian
Axillary
Brachial
Radial or ulnar
Graft: anastomotic aneurysm (defined by arterial inflow and outflow sites, or graft location)

Aneurysms may affect branches of aforementioned arteries and are reported by noting such, or by using specific name of vessel (i.e., middle sacral, digital and the like).

Table III. Etiologic classification of arterial aneurysms

Congenital (developmental)
Ehlers-Danlos syndrome, Marfan's syndrome
Mechanical (hemodynamic)
Poststenotic, arteriovenous fistula-associated
Traumatic
Blunt or penetrating trauma
Inflammatory (noninfectious)
Takayasu's disease, Behcet's disease, Kawasaki's disease, microvascular disorders (i.e., polyarteritis), periarterial inflammatory disease (i.e., pancreatitis)
Infectious
Bacterial, fungal, spirochetal
Degenerative
Nonspecific (commonly considered arteriosclerotic); dysplastic
Anastomosis; Postarteriotomy (See classification anastomotic aneurysms, Table IV)

Other examples exist in all of the above classes, and should be specifically identified when reported.

Table IV. Etiologic classification of anastomotic aneurysms

Infection
Clinically suspected but Gram stain and culture negative; proven (positive culture and/or Gram stain of arterial wall, graft, contents of aneurysm or wall of aneurysm); specific organisms should be reported
Arterial wall failure
Wall normal but suture pulled out; wall normal but previous endarterectomy; degeneration or aneurysmal changes in arterial wall
Suture failure
Graft failure
Dilation; degeneration (frayed, fractured); excessive tension
Unknown

and the like. Infectious aneurysms, often referred to as mycotic aneurysms, should be classified on the basis of (1) the infectious agent, (2) route of entry or source of the organism (such as blood borne, penetrating or iatrogenic trauma, spread from contiguous infection, erosion of aneurysm into bowel, operative contamination), and (3) preexisting pathologic features of the arterial wall (normal, atherosclerotic, aneurysmal and the like).

Anastomotic aneurysms are unique in many respects and should be classified by cause (Table IV). It may be difficult to establish the presence of a low-grade infection, especially when caused by organisms such as *Staphylococcus epidermidis,* unless ultrasonic oscillation or some other mechanical process is used to free the bacteria from the graft and its capsule, an excised piece of the arterial wall, or the contents and wall of the aneurysm. In reporting anastomotic aneurysms, it is important to document the primary operation (indication, operative procedure, graft material, and suture type), the development of local vascular and nonvascular complications (including infection, lymphatic abnormalities), secondary operations at the same site of the pseudoaneurysm, systemic risk factors, and pathologic characteristics of the aneurysm. The time of occurrence or recognition of the anastomotic aneurysm in relation to the primary procedure should be noted.

Morphology – histology

The important morphologic features of an aneurysm should be reported, including its dimensions (anteroposterior, lateral, and length), shape (fusiform and saccular), relationship to branches, and arterial wall complications as defined below. The use of the descriptive terms "small," "large," and "giant" to describe aneurysms should be avoided. However, in some reports if the dimensions clarifying these terms are included, their use may be justified. The histopathology of the aneurysmal wall should be reported when known.

Clinicopathologic manifestations

Classification of the clinicopathologic manifestations of an aneurysm includes those of a benign nature (such as pulsatile mass, distortion of adjacent organs or tissues) that accompany an asymptomatic aneurysm, as well as those complications that may be associated with symptomatic aneurysms (Table V). When expansion of an aneurysm is observed, the rate of expansion should be documented. Rupture of an aneurysm is defined by the presence of blood outside the true arterial wall. Noninfectious inflammatory abdominal aortic aneurysms are classified on the extent of involvement of the aorta (including infrarenal arteries, aorta, and iliac arteries) and surrounding structures (such as the duodenum, ureters, and renal vein). The ischemic consequences of thrombosis of an aneurysm or embolization involving the extremities are classified as acute or chronic, and are further categorized on the basis of the clinical and objective criteria previously described in detail in the Reporting Standards for Lower Extremity Ischemia.[20]

A classification of the central hemodynamic status of the patient, based on standard clinical criteria including blood pressure, urine production, and the response to resuscitation is relevant to reports on aneurysms. In general the hemodynamic status may be defined as (1) stable, (2) unstable (transient, incomplete or transient response to resuscitation, as well as no response to resuscitation), (3) cardiac arrest, and (4) death. In reporting these details the patient's initial condition on presentation to a medical facility and at the time of operation should be recorded. In addition, the time interval between the onset of symptoms and treatment should be noted.

The function of a specific organ or limb supplied by an aneurysmal artery should be defined. A simple manner of presenting these data is (1) normal function, (2) transient dysfunction, (3) permanent dysfunction, (4) transient total loss of function, and (5) permanent total loss of function. The existing reporting standards for peripheral arterial occlusive disease,[20] cerebrovascular disease,[21] and venous disease[22] may be useful in quantitating organ or limb function.

Table V. Clinicopathologic manifestations of arterial aneurysms

None
Expansion
Compression
Nerve, vein, gastrointestinal, genitourinary, bone, trachea, or bronchi
Erosion (bone, trachea)
Rupture
Contained by surrounding connective tissue (i.e., ruptured into potential space) acute, chronic
Uncontained fistulization into adjacent organ (vein, intestine, pancreaticobiliary tract)
Free rupture (peritoneal or pleural space, external)
Thrombotic occlusion
Embolization
Macroembolization, microembolization
Dissection
Inflammatory, noninfectious
Infectious

ANATOMIC DEFINITION (diagnostic tests)

Accurate description of the maximum external transverse or anteroposterior diameters, extent, and sites of arterial aneurysmal involvement are important for the proper interpretation of natural history studies or reports on the treatment of aneurysms.

In some reports physical examination alone may provide adequate documentation, especially for peripheral aneurysms. Measurements from plain roentgenograms, when corrected for magnification, may be used to report the maximum diameter of an aneurysm with calcification of the wall. Although angiography is not generally useful for determining the maximum diameter of an aneurysm because of the presence of mural thrombus, it will provide useful information on the precise localization and extent of the aneurysmal disease, as well as the presence of coexisting arterial occlusive disease. Criteria for measuring the size of an aneurysm by ultrasonography or CT scanning and the limitations of these techniques are relevant to standards of reporting on aneurysms.

Ultrasonography. Because of the frequent tortuosity of aneurysmal arteries, it is essential for those reporting on aneurysms to ensure that measurements are made in a plane perpendicular to the axis of the artery, otherwise the recorded diameters may be made in an oblique plane and will overestimate the true size of the aneurysm. This artifact can be suspected if the anteroposterior and lateral measurements differ significantly from each other. This error can be minimized by using a probe angle that produces an image of the aneurysm that is as circular as possible. The anterior and lateral margins of an abdominal aortic aneurysm are usually identified by the sonolucent (black) layer that surrounds the aorta. The posterior margin is often less distinct and should be defined as the most posterior layer that is contiguous with the extrapolated lateral walls of the aneurysm. Currently it is not known if the length of an aneurysm or the extent of mural thrombus are of clinical importance. Doppler recordings are useful for determining if an aneurysm is thrombosed.

Computed tomography. As with ultrasound studies, CT scanning may overestimate the diameter of an aneurysm if the artery is tortuous and not perpendicular to the plane of the tomographic section. Furthermore, if the outside wall of the aneurysm slopes significantly within the tomographic slice, its edge may be indistinct, and measurements will be potentially in error.

ADDITIONAL RELEVANT FACTORS IN PATIENTS WITH ANEURYSMS

Family history of aneurysmal disease is a significant risk factor for the development of abdominal aortic aneurysms and details on at least each first degree relative (i.e., mother, father, siblings, and children) should be recorded in reports regarding cause.

Certain other factors should also be reported since they may be associated with the development of aneurysms including factors such as age, sex, race, hypertension, chronic obstructive lung disease, malignancy, number of pregnancies, intravenous drug abuse, immunologic incompetence, and alcoholic pancreatitis.

Important factors related to the management, surgical risks, and late survival of patients with arterial aneurysms must be noted when reporting on aneurysms include severity of cerebrovascular disease; cardiac risk factors as defined by clinical grading, ECG, noninvasive tests of cardiac function and/or coronary angiography; pulmonary risk; renal risk; and arterial occlusive disease risk factors. Detailed discussion of these factors are provided in the reporting standards for lower extremity ischemia and should serve as a basis for describing similar risks in reports on aneurysms.[20]

DETAILS OF OPERATION

To interpret surgical results a detailed description of the operative procedure is necessary. It is important to note whether the operation was performed on an emergent, urgent, or elective basis. Emergent procedures are undertaken as soon as possible (i.e., within 4 hours) because of an immediate threat to life or organ. Urgent procedures are performed with a minimum of preoperative preparation (i.e., within 24 to 36 hours). Elective procedures are performed at the convenience of both the patient and surgeon.

Certain technical details should be included when reporting on operations for abdominal aortic aneurysms (Table VI). Information regarding exposure, arterial control above or below the renal vessels, and means of organ protection are particularly relevant to aortic aneurysm operations. In reporting popliteal aneurysms, the approach (medial or posterior), method of repair, distal site of anastomosis, graft material, and adjunctive procedures are of similar importance. Since aneurysms in the thoracic outlet may be associated with thoracic outlet abnormalities, particulars on concomitant resection of a cervical or first rib should be documented. Additional details relevant to carotid and brachiocephalic aneurysm repair are provided in the reporting standards for cerebrovascular disease.[21] These reports should include the method of cerebral protection (such as no shunt or shunt), method of monitoring (stump pressure, EEG, awake, and the like), and type of anesthesia. The standards also apply to splanchnic and renal aneurysms. Concomitant bowel operations and renal procedures should be recorded in reports on these aneurysms.

PERIOPERATIVE MANAGEMENT

The details of the perioperative management may be important in certain reports on the results of operations for aneurysms, and should be detailed in reports on outcome (Table VII). In as much as certain preexistent factors affect both the conduct of operation as well as outcome, they should be stated in reports on aneurysm treatment. The following particular risk factors should be accounted for: diabetes mellitus, tobacco use, hypertension, hyperlipidemia, cardiac status, cerebrovascular status, renal function, and pulmonary function. Although somewhat simplistic, the grading system of these factors as proposed in the standards reports on lower extremity ischemia[20] and cerebrovascular disease[21] may serve as a useful framework for reports on aneurysms.

OUTCOME ASSESSMENT

Ideally, the results of surgical treatment for aneurysms should be compared to the natural history of the aneurysmal disease. Unfortunately, reliable information on the latter is lacking for most arterial

Table VI. General details of operation for arterial aneurysms

Emergent, urgent, or elective operation
Basic treatment of aneurysm
None, excision, ligation, reinforcement
Establishment of arterial continuity
None, aneurysmorrhaphy, interposition graft, bypass, (anatomic, nonanatomic),
Primary reanastomosis, reimplantation
Operative incision and aneurysm exposure
Site of arterial control (proximal, distal)
Site of anastomosis (proximal, distal)
Total arterial occlusion time (min)
Method of organ protection (kidney, spinal cord, brain)
Graft
Material, configuration, size (diameter and length)
Other procedures
Adjunctive vascular (one that aims to augment the principal vascular repair)
Ancillary vascular (one that does not contribute to the effects of the vascular repair)
Concomitant nonvascular operations

These issues should be addressed especially when reporting on arterial aneurysm management and outcome.

aneurysms. Hence, in descriptive outcome studies success should be defined by means of the following criteria: patient survival, patency of the arterial reconstruction, and the absence of significant vascular or nonvascular complications.

COMPLICATIONS

Mortality—survival

Both early and late mortality rates should be reported. Death from any cause within the first 30 postoperative days is considered to have been caused by the effects of the surgical procedure, an early (perioperative) death. Early deaths may be related to factors such as the severity of vascular disease, coexisting systemic diseases, and the quality of the medical care including precision of diagnosis, judgment regarding surgical intervention, operative technique, and perioperative nonsurgical management. Deaths occurring more than 30 days after operation may be related to the natural history of the primary vascular disease, perioperative complications, or unrelated systemic diseases. In all cases the cause of death should be documented.

Patency of arterial reconstruction

Criteria for establishing the patency of grafts in the extremities have been defined previously.[20] For other sites if a graft is used, noninvasive, functional, or invasive studies may be used to assess patency, and data regarding such should state the specific methodology used.

Table VII. Details of perioperative care (especially for aortic aneurysm repair)

Vital signs, monitoring methodology
Renal function
Antibiotics: type, duration
Cardiac, vascular drugs: type, duration
Renal drugs: type, duration
Anticoagulants: type, systemic or regional, duration
Blood loss, blood replacement
Crystalloid administration
Anesthetic: type, duration
Ventilation: duration
Postoperative hospitalization: duration

These issues become important in assessing outcome, and should be reported in sufficient detail in such reports to allow a clear understanding of events affecting outcome other than the basic treatment methods.

Complications

Both early complications and late complications that are specific to the operation or the underlying disease process should be reported. In general, the consequences of any complication can be classified as to its effect on the resulting function of the specific organ or limb involved, in a manner similar to that of the underlying aneurysm itself. The recommendations for classifying complications described in the reporting standards for lower extremity arterial disease[20] are generally applicable to operations for aneurysms and include (1) local vascular complications, (2) remote vascular complications, (3) local nonvascular complications, and (4) systemic nonvascular complications.

Statistical methods

Appropriate statistical methods of assessing outcome are exceedingly important in reporting on arterial aneurysmal disease. Many statistical tests may be applied to reporting aneurysm data provided they represent accepted analytic methods.[23,24] Two specific means of assessing data regarding arterial aneurysms deserve note.

Life-table analysis. Long-term results of operative therapy or natural history data are best presented by use of life-table analysis. This defines survival function, that is, the curve of the cumulative percent survival success or patency rates versus time of follow-up. The actuarial method or the Kaplan-Meier (product-limit) method are usually used.[25,26] The latter is preferable under most circumstances, because it provides results independent of the choice of the time of intervals studied. The standard error of each estimate should be calculated. To test if there is a statistically significant difference between two survival curves, the generalized Wilcoxon (Breslow) test or the log-rank (Mantel-Cox) test should be used.

Cox proportional hazards model. This is a contemporary statistical method that allows evaluation of the effects of multiple variables on outcome. It can be used to (1) determine which combination of the multiple variables are associated with survival or success and (2) to estimate the chance of survival or success for all combinations of the significant variables.

REFERENCES

1. Aronberg DJ, Glazer HS, Madsen K, Sagel SS. Normal thoracic aortic diameters by computed tomography. J Comput Assist Tomogr 1984;8:247-50.
2. Dotter CT, Steinberg I. The angiocardiographic measurement of the normal great vessels. Radiology 1949;52:353-8.
3. Steinberg CR, Archer M, Steinberg I. Measurement of the abdominal aorta after intravenous aortography in health and arteriosclerotic peripheral vascular disease. AJR 1965;95:703-8.
4. Horejs D, Gilbert PM, Burnstein S, Vogelzang RL. Normal aortic diameters by CT. J Comput Assist Tomogr 1988; 12:602-3.
5. Dixon AK, Lawrence JP, Mitchell JRA. Age-related changes in the abdominal aorta shown by computed tomography. Clinical Radiology 1984;35:33-7.
6. Callum KG, Gaunt JI, Thomas ML, Browse NL. Physiological studies in arteriomegaly. Cardiovasc Res 1974;8:373-83.
7. Hugues CJ, Safar ME, Aliefierakis MC, Asmar RG, London GM. The ratio between ankle and brachial systolic pressure in patients with sustained uncomplicated essential hypertension. Clinical Science 1988;74:179-82.
8. Hugue CJ, Asmar RG, London GM, Safar ME. Age and sex-related changes in the ration between ankle and brachial systolic pressure in normal subjects. Angiology 1988; 219-24.
9. Collin J, Araujo L, Walton J, Lindsell D. Oxford screening programme for abdominal aortic aneurysm in men aged 65 to 74 years. Lancet 1988;2:613-5.
10. Lilly MP, Harward TRS, Flinn WR, et al. Duplex ultrasound measurement of changes in mesenteric flow velocity with pharmacologic and physiologic alteration of intestinal blood flow in man. J Vasc Surg 1989;9:18-25.
11. Lewis P, Psaila JV, Davies WT, McCarty K, Woodcock JP. Measurement of volume flow in the human common femoral artery using a duplex ultrasound system. Ultrasound Med Biol 1986;12:777-84.
12. Davis RP, Neiman HL, Yao JST, Bergan JJ. Ultrasound scan in diagnosis of peripheral aneurysm. Arch Surg 1977;112:55-8.
13. Fitzgerald DE, O'Shaughnessy AM. Cardiac and peripheral arterial responses to isoprenaline challenge. Cardiovasc Res 1984;18:414-8.
14. Christensen T, Jorgensen J, Neubauer B. Diameter and pulsatile oscillations of the femoral artery recorded by ultrasound. Acta Radiol Diagn 1984;25:313-6.
15. Williams MA, Nicolaides AN. Predicting the normal dimensions of the internal and external carotid arteries from the diameter of the common carotid. Eur J Vasc Surg 1987;1:91-6.
16. Benetos A, Safar ME, St Laurent, Bouthier JD, Lagneau PL, Hugue C. Common carotid blood flow in patients with hypertension and stenosis of the internal carotid artery. J Clin Hypertens 1986;1:44-54.
17. Simon AC, Levenson J, Cambien F, Bouthier J. Combined effects of gender and hypertension on the geometric design of large arteries. Sexual differences in normal and hypertensive forearm arteries. Am J Hypertens 1988;1:119-23.
18. Safar ME, Peronneau PA, Levenson JA, Toto-Moukouo JA, Simon AC. Pulsed Doppler: diameter, blood flow velocity and volume flow of the brachial artery in sustained essential hypertension. Circulation 1981;63:393-400.
19. Levenson JA, Peronneau PA, Simon A, Safar ME. Pulsed Doppler determination of diameter, blood flow velocity, and volumic flow of brachial artery in man. Cardiovasc Res 1981;15:164-70.
20. Rutherford RB, Flanigan DP, Gupta SK, et al. Prepared by the Ad Hoc Committee on Reporting Standards, Society for Vascular Surgery/North American Chapter, International Society for Cardiovascular Surgery. Suggested standards for reports dealing with lower extremity ischemia. J Vasc Surg 1986;4:80-94.
21. Baker JD, Rutherford RB, Bernstein EF, et al. Prepared by the Ad Hoc Committee on Reporting Standards, Society for Vascular Surgery/North American Chapter, International Society for Cardiovascular Surgery. Suggested standards for reports dealing with cerebrovascular disease. J Vasc Surg 1988;8:721-9.
22. Porter JM, Rutherford RB, Clagett GP, et al. Prepared by the Ad Hoc Committee on Reporting Standards, Society for Vascular Surgery/North American Chapter, International Society for Cardiovascular Surgery. Reporting standards in venous disease. J Vasc Surg 1988;8:172-81.
23. Colton T. Statistics in medicine, Boston: Little, Brown, 1974.
24. Woolson RF. Statistical methods for the analysis of biomedical data. New York: John Wiley & Jons, 1987.
25. Peto R, Pike MC, Armitage P, et al. Design and analysis of randomized trials required prolonged observation of each patient. II. Analysis and examples. Br J Cancer 1977;35:1-38.
26. Coldman AJ, Elwood JM. Examining survival data. Can Med Assoc J 1979;121:1065-71.