Angioscopy

By Marge B. Lovell, and Kenneth A. Harris

History

Angioscopy or Cardioscopy,as it was first called, is a technique for direct visualization of the inside of blood vessels and heart.The first recorded endoscopic cardiovascular procedure was in 1913 by Rhea and Walker[1] when they attempted cardioscopy in dogs.Intra cardiac surgery and the development of the cardioscope paved the way for the development of the angioscope.The first clinical studies of arterial endoscopy were done by Pinet et a1,[2] who tried to look inside blood filled unclamped vessels by perfusing them with saline. Early attempts at peripheral vascular endoscopy in dogs were done by Greenstone et al in 1966[3];using a flexible choledochoscope in live dogs and in human cadaver aortas; blood flow was temporarily obstructed with a clamp and saline was used to clear the field for better viewing. No further studies are documented until 1974; when Jorge Vollnar, by using a variety of instruments was able to define the basic principles of vascular endoscopy.[4] A pressure infusion of saline was used to clear the field after a clamp or balloon catheter had arrested inflow. Carotid endoscopy in cadavers was studied by Olinger in 1977.[5] He found that vessels that appeared normal by arteriography frequently contained plaques and thrombi;this proved to be a significant advance in the diagnosis and management of carotid artery disease and strokes.

Abstract

Over the past three to four decades vascular surgery has experienced increasing interest and rapid growth.This surgical speciality continues to show an annual increase in the number of procedures performed,and demonstrates increasing use of innovative technology. The author explains how the angioscope has emerged as a potentially powerful diagnostic tool for today's vascular surgeon. Its implications, complications and the post operative nursing care for the patient undergoing angioscopy will be discussed.

Current Use

Today the angioscope is widely used by the vascular surgeon in a variety of clinical settings.It is used: intraoperatively to identify technical errors, particularly of anastomoses and endarterectomy sites; following laser angioplasty for native artery visualization- areas not well seen by angiography. It is very useful in insitu vein bypass assessment intraoperatively and allows immediate correction of technical errors and elimination of missed valves during surgery. It allows the vascular surgeon direct inspection of vessels post embolectomy and thrombectomy.

The angioscope permits the surgeon to identify intraluminal pathology and gives further insight to areas of restenosis and late graft failure. Angioscopy promises to provide an efficient and practical alternative to arteriography as demonstrated in Table 1. Perhaps the most important disadvantage of angioscopy compared to arteriography is that it does not provide full visualization of the runoff vessels - for example after femoral tibial reconstruction or embolectomy.

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Table 1
Advantages

Angioscopy	Arteriography
- 3 Dimensional	2 Dimensional
- Colour	Black and White
- No contrast used	Contrast used
- No radiation exposure	Radiation exposure
- Direct visualization of anatomic detail and clots	Not seen by angio
- Defects can be corrected under direct visualization	Cannot be done by angiography

Current State of Art Technology

The basic components of an angioscopic system consist of a flexible fiberoptic scope, a light source and an irrigation system. Together these create the image that allows the vascular surgeon direct visualization of arteries and veins. Television cameras, monitors and video recorders expand the utility of the angioscopic system by providing permanent recording for display and educational purposes.

The flexible angioscope is used today. They range in size from 0.55 to 0.95 mm. in external diameter to access vessels from 0.7 to 1.8 mm. in internal diameter. Each angioscope is composed of a central viewing bundle containing 4000 to 8000 fibers and a concentric ring of illuminating fibers.

Heparinized saline(1000 units/1000 mls) is used as an irrigating solution delivered by a pressurized system with a catheter placed into the lumen. The angioscope is inserted through proximal or distal arteriotomy sites, synthetic graft material, distal anastomoses or venous graft side branches before release of proximal vascular control. By gentle rotation the scope is guided, advanced, withdrawn and the vessel is externally manipulated . This procedure is currently done in the operating room, during peripheral vascular surgery and with further technological advances, it could potentially reduce graft failure and improve limb salvage rates.This is used in some centres to replace on table or completion angiography.

Complications and Postop Nursing Care

Vascular Endoscopy is associated with few complications when performed by experienced investigators. Also with the advent of smaller scopes there has been less damage to vessels studied. Complications of endoscopy can be divided into three categories: systemic, traumatic and ischemic. Systemic include infections and sepsis from the use of the device, as well as fluid overload because of the need for irrigation fluid to clear blood so the vessel can be visualized. Following revision of the procedure and the introduction of a closed perfusion system, this has ceased to be a problem[6].

The development of miniature cameras which allows the image to be projected onto a television monitor is an advance, the surgeon no longer has to worry about contamination between his periorbital tissue and the scope as it is manipulated in the artery,and everyone in the operating room can view the study simultaneously. Also the fact that most vascular surgeons use prophylactic antibiotics probably contributes to the low incidence of infection.

Fluid overload is probably the greatest problem encountered in vascular endoscopy, because of the need for obtaining a bloodless field that allows clear visualization. Even the smallest amount of blood obscures the vision and prevent precise evaluation of the luminal surface. Several techniques have been designed to prevent this problem; the easiest and most straightforward is to perform endoscopy on an isolated vascular segment. The type of procedure that I speak about would be the carotid endarterectomy and distal bypass to the lower extremity; the amount of irrigating fluid used is minimal because the residual blood in the vessel can easily be irrigated away,and none of the irrigation fluid reaches the patients intravascular space. Another technique to avoid fluid overload is a fluid filled balloon, which when inflated prevents antegrade flow. Generally the infusion is limited to 500 mls. of normal saline and the procedure is performed in less than five minutes.

Vessel injury or traumatic complications

It is easy to see how passing a foreign body into vessels can cause trauma such as perforation endothelial damage, spasm, embolization, thrombi or hemorrhage.Vessel complications of vascular endoscopy are obviously related to the size of the scope in relation to that of the vessel. From reviewing literature reports of studies there have actually been

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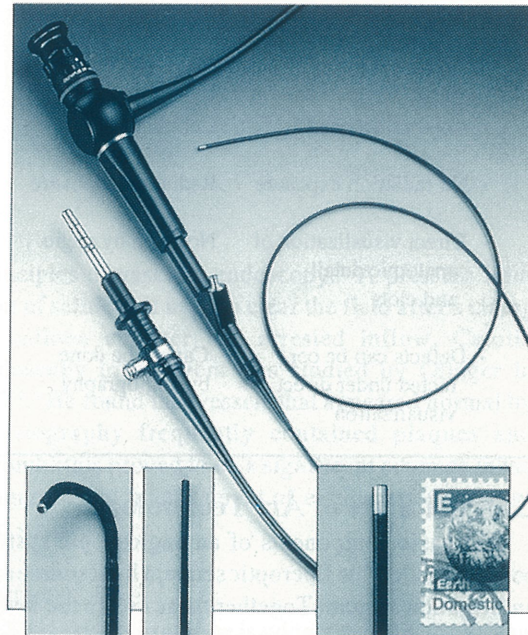

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very few vascular injuries. In a series of five hundred operations, Vollmar reported no vessel complications[7]. White et al reported transient vessel spasm in three patients (12.5% of their series) when the angioscope was introduced into tibial vessels[8]. From our experience endothelial damage is the most frequent complication, and this may lead to early or late postoperative graft thrombosis.

Ischemic complications consist of those related to the effects of partial or total occlusion of the vessel being evaluated. The areas primarily affected are the central nervous system, the renal arteries and the heart.Ischemia is not usually a factor in the leg, which can tolerate ischemia for several hours.

Post operative nursing care of these patients include: assessing the incision, extremity evaluation for pulses, warmth etc, vital signs, wound care and special emphasis on the above mentioned complications. Careful attention must be emphasized to fluid overload, which may not occur for several hours post op.The need for continued education and follow up is very important for these patients as for all peripheral vascular patients.

Care of Equipment

Angioscopy equipment is expensive and delicate,therefore it is mandatory that nursing personnel are aware of the care of the angioscope. One should always handle the angioscope carefully. Squeezing, kinking, or stretching should be avoided,as the glass fibers break easily. Do not allow the scope or the light cable to hit any hard surfaces.The light cable should be grasped by the strain relief handle only. When not in use, the angioscope and the transport channels should be rinsed to prevent drying of foreign matter. The light source should never be left on when not in use, since it may come in contact with surgical drapes that could be flammable.The equipment should be cleaned with a mild detergent and rinsed and dried well.Protective caps or vents on the scopes must be used when immersing them in solution or sterilizing them in gas. Instruments should be placed in containers for sterilization.The camera lens must be kept clean and dry. Although no medical devices are indestructible the life expectancy of the angioscope will be increased significantly by careful handling.Some hospitals appoint special nursing teams to care for delicate endoscopy equipment.

Conclusion

In summary,vascular endoscopy is in a phase of rapid development with refinements occurring in both techniques and equipment. Angioscopy now allows for further diagnostic and therapeutic intervention in vascular surgery. This field is only beginning to unfold and holds great hope for the future for the vascular surgeon and all vascular surgery patients.

References

(1) Rhea L. and Walker I.G., The surgical treatment of mitral stenosis: Experimental and clinical studies. *Arch. Surg.* 9:689,1924

(2) Pinet F., Archimbaud J.P., Problems posed by cardiovascular endoscopy. *Presse Med.* 74:351,1966

(3) Greenstone S.M., Shore J.M., Heringman E.C., Massell T.B.: Arterial endoscopy (Arterioscopy). *Arch. Surg.* 93:811-812,1966

(4) Vollmar J.F., Storz L.W. Vascular endoscopy: Possibilities and limits of its clinical application. *Surg. Clin. North America.* 54: 111,1974

(5) Olinger C.P.: Carotid artery endoscopy (Autopsy). *Surg. Neurol.* 7:7-13,1977

(6) Vollmar J.F., LoePrecht H., Hutschenreiters: Advances in vascular endoscopy. *Thorac Cardiovasc. Surg.* 35:334-341,1987

(7) Vollmar J.F., Storz L.W. Vascular endoscopy: Possibilities and limits of its clinical application. *Surg. Clin. North America.*54 111,1974

(8) White G.H., White R.A., Kopchak G.E., et al: Intraoperative video angioscopy compared with arteriography during peripheral vascular operations. J. *Vasc. Surg.* 6:488-495,1987