based, it is important to endeavor to move toward offering these programs through recognized educational facilities and coordinating more standardized curriculae to allow to unity, compensation and movement.

I would like to add that not every perioperative nurse is interested in these advanced roles, nor will there be sufficiently large numbers of opportunities to everyone to fill them. However, each perioperative nurse should be committed to enhancing their curent practice as much as possible. As acuity of hospitalized patients increases, advanced knowledge is necessary to provide them with the safest care possible. As CNA's study predicts, a severe nursing shortage is looming in the future, (See page 13). Take this opportunity to be the expert in your speciality. Add to your credentials by furthering your education through certification, post-basic courses, degree programs and self-learning. Determine your own destiny and the destiny of your patients.

While we must show gratitude to those pioneers, both in the 40's and in the 90's, we must also determine the future of perioperative nursing, and ensure that it is valued and promoted. ■

References

CNA. (1997). The future supply of registered nurses: a discussion paper.

Groah, L.K. (1990). Operating Room Nursing Perioperating Practice. (2nd ed.) Norwalk, Connecticut, Appleton & Lange.

Groetch, G. (1997). RN First Assistant - 1997 Canadian Update. Canadian Operating Room Nursing Journal, 15 (2), 13-16.

Kitson, A.L. (1997). Johns Hopkins address: Does Nursing have a Future ? Image. Journal of Nursing Scholarship, 29 (2) Second Quarter. 111-115.

Endovascular Repair of Abdominal Aortic Aneurysm:

An Alternative to Conventional Surgery

By Shari Jones, RN, BScN, CPN(C) & Regina Ludwa, RN, CPN(C)

New technology has been developed to allow the vascular surgeon to insert a vascular graft into the abdominal aortic aneurysm (AAA) sac via a femoral arteriotomy, much the same as an angioplasty is performed. The endovascular prosthesis is an alternative to the traditional vascular graft, which requires major abdominal surgery.

Aneurysms may occur in any section of the aorta with approximately 80% occurring in the abdominal segment (Fellows, 1995). The majority of AAA's are infra-renal, and may extend into the common iliac arteries (Meeker & Rothrock, 1995.

The most common cause of AAA's is atherosclerosis. Other causes are classified as inflammatory, mechanical, pseudoaneurysms, and congenital. The incidence of AAA is reported at approximately 2% of elderly persons in North America, occurring more often in men (Hatswell, 1994). The majority of patients will have medical conditions such a hyperlipidemia, hypertension and arteriosclerosis, which will compromise the cardiovascular system.

Abstract

The majority of aortic aneurysms occur in the abdominal segment. Aneurysms above 5 cm are at higher risk for rupture, and have traditionally been treated with surgical intervention. Conventional surgical treatment involves major abdominal surgery with associated complications. The endovascular prosthesis is a newly developed vascular graft which is inserted into the abdominal aortic aneurysm sac via a femoral arteriotomy. The procedure is less invasive for the patient, which is a significant benefit considering many patients with an abdominal aortic aneurysm are medically compromised. Thorough preoperative planning by the surgical and radiological teams is critical to ensure a successful patient outcome.

Abdominal aortic aneurysms may be managed medically or surgically. The average abdominal aorta is approximately 2cm in diameter. Aneurysms under 5 cm, with low risk of rupture, may be treated medically. This includes life-style changes, antihypertensive medications, and frequent follow up with ultrasound to detect further growth of the aneurysm. Aneurysms above 5cm are considered at a higher risk for rupture and will generally be considered for surgical intervention, particularly in the presence of symptoms (Hatswell, 1994).

Abdominal aortic aneurysms have traditionally been surgically repaired using a knitted or woven double velour vascular graft. The repair involves major abdominal surgery, associated complications, and a length of stay of 8 -10 days. The mortality rate for surgical intervention is reported at 4% (Blum et al., 1997).

Endovascular Prosthesis

The endovascular prosthesis was developed in Germany, with the first reported use in a patient in

Authors

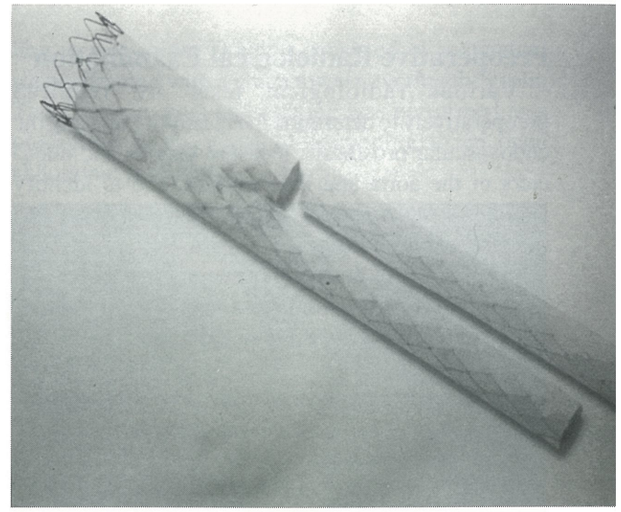
Shari Jones, RN, BScN, CPN(C) at the time of writing was Patient Care Educator, Perioperative Services, The Wellesley Central Hospital, Toronto. She is currently Educator, OR, Humber River Regional Hospital, Weston, Ontario.

Regina Ludwa, RN, CPN(C) is the Charge Nurse for the Neurosurgery and Peripheral Vascular Services at The Wellesley Central Hospital, Toronto.

1991 (Blum et al., 1997). The endovascular prosthesis is a self-expanding vascular graft consisting of a woven polyester fabric sheath covering a nitinol wire stent. Anchoring barbs on the proximal portion of the graft facilitate adherence of the graft to the aortic wall. It is produced in various diameters and lengths, and is either straight or bifurcated. The bifurcated graft is manufactured with only one iliac leg; a tapered iliac extension is inserted into the opposite leg of the graft after the main graft is positioned in the aneurysm sac *(Meadox Medicals, Inc., 1997)*.

The endovascular prosthesis is enclosed in a flexible 21 Fr introducer system. Prior to insertion, the introducer system must be chilled in iced saline slush solution. This will make the introducer system rigid and the nitinol wire stent flexible. Once the prosthesis is expelled from the introducer, the nitinol wire stent will expand when exposed to body temperature. The prosthesis is moulded to the configuration of the aorta with a balloon located inside the introducer system. Other features of the endovascular prosthesis include low water permeability and platinum markers for alignment of the prothesis.

The endovascular prosthesis is generally used for infra-renal abdominal aortic and aortoiliac aneurysms. However, it has been used for repair of thoracic aortic aneurysms (Blum et al., 1997). The diameter of the selected prosthesis must be slightly larger than the diameter of the aorta, to ensure adequate occlusion. Radiological techniques are employed to insert the prosthesis into the aortic aneurysm sac through a femoral arteriotomy. This is a significant advantage considering many patients with an AAA have medical conditions that classify them at high risk for major abdominal surgery.



Bifurcated Graft

Patient Selection

Appropriate patient selection for the endovascular prothesis procedure is essential. The AAA must be infra-renal or in the aorto-iliac segment. The aneurysm must be at least 4 cm in diameter (Meadox Medicals, Inc., 1997). Contraindications for the use of the endovascular prosthesis are listed in **Table 1.**

Table 1

Contraindicated for the use of Endovascular Prosthesis

- ruptured aneurysm
- creatine level higher than 1.7 mg/dl indicating renal dysfunction
- life expectance less than one year
- compromised inferior mesenteric artery flow
- presence of an aortic or iliac vascular prosthesis or stent
- pregnancy
- coagulopathy or chronic anticoagulant therapy
- systemic or groin infection
- allergy to contrast media
- obesity which would interfere with incision site access or visualization
- patient unable to adhere to follow-up regime
- aneurysm related to Marfan's syndrome
- known or suspected mycotic aneurysm; or other infection
- current participation in medical rials
- horseshoe kidney
- <1.5cm normal aorta below renal arteries
- proximal aortic attachment site is tapered
- proximal aortic attachment site is <20mm or >25mm
- <1.5cm normal common iliac artery
- distal ilias attachment site >13mm in diameter

Preoperative Radiological Examination

Various radiological tests are required preoperatively to determine the feasibility of using the endovascular prosthesis, measure lengths and diameters of the aorta and iliac arteries, and to identify anomalies that may complicate the procedure. The radiological test performed include:

- ultrasound - for initial screening;
- CT scan - for initial screening;
- spiral CT - if patient is an appropriate candidate for surgery;
- multiplanar reconstruction - for reconstruction images of the aorta and iliac arteries;
- angiography; and
- pull - back measurements - to measure distance from the renal arteries to the aortic bifurcation. (Meadox Medicals, Inc., 1997)

Informed Consent

The endovascular prosthesis is a new surgical device with government approval for research only. A special informed consent must be obtained along with the routine informed consent for surgery.

Procedural Considerations

The procedure is ideally performed in an O.R. equipped with specialized radiological equipment, and a radiolucent O.R. table. The ideal radiological system includes:

- ceiling mounted C-arm & 12" image intensifier;
- digital subtraction angiography & replay facility;
- facility for arterial road mapping
- variable fluoroscopy doses and/or pulse fluoroscopy
- ability for hard copies
- appropriate room protection (Meadox Medicals, Inc., 1997)

Case Study

Mr. A. is a 71 year old male diagnosed with an infra-renal AAA, admitted for endovascular placement of an abdominal aortic graft. His medical history includes an MI in 1996, and a duodenal ulcer. He was classified as a Grade IV ventricle at high surgical risk. Mr. A. has an automated pacemaker/defibrillator to regulate his heart rate. Previous surgery includes a cholecystectomy.

Preoperative Preparation

Patient Preparation

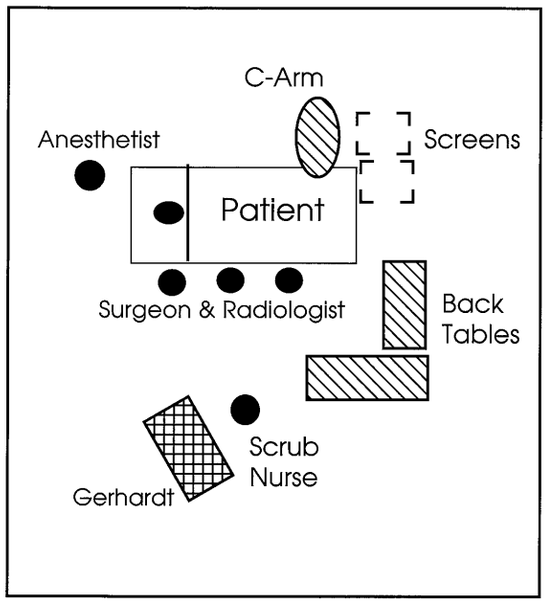
A CT scan and abdominal ultrasound were performed prior to the procedure to ensure the aneurysm was infra-renal and for measurements of the aorta and iliac arteries. Other radiological tests performed included an angiogram, chest x-ray and spiral CT scan.

Mr. A. was admitted two days prior to surgery. Preoperative preparation included an ECG, 2 D echo doppler, CBC, electrolytes, BUN, creatinine, IVR, PTT, blood sugar, baseline serum lactate, and a C&T for 4 units of packed cells. A routine informed consent and a special procedures consent were obtained.

Procedure Preparation

Our O.R. was not equipped with the ideal radiological equipment, therefore, the procedure was performed in the Special Procedures Room in Radiology. The layout of the Special Procedures Room provided adequate space for the sterile set-up, the surgical team, and would allow for proper traffic control. Thorough planning by the radiology and perioperative teams, and the endovascular prosthesis company representative, was critical to ensure all necessary supplies and equipment were available, and to anticipate untoward events. A diagram of the room set-up is illustrated in the graph below.

Figure 1. *Procedure Room Set-Up*



The standard case cart for an open AAA repair was used, which included a major vascular tray. The use of a major vascular tray was a precaution in the event of converting to an open procedure. The initial count consisted of sponges, needles, blades, reels, vessel loops, liga clip cartridges and bovie tip. The instrumentation was not counted; in the event of the surgery being converted to an open procedure, the imaging equipment was present to perform a postoperative x-ray of the abdomen.

Two back tables were used to assemble the radiology supplies and immerse the endovascular prosthesis in iced saline slush. The challenge was to obtain a container long enough to accommodate the introducer system without coiling or bending it. An appropriate sized container could not be located, therefore a long sterile peel package pouch was used. The package was sealed at both ends and incised down the centre to create a "boat". This allowed the iced saline slush to be contained within the package and the introducer system to lie flat.

Special Radiology supplies included various guidewires (J-tip and angled), pigtail angiographic catheter, various imager catheters, and a wire snare loop. Routine supplies used for angiography procedures were also made available, including a long ruler with radiopaque markings.

Intraoperative

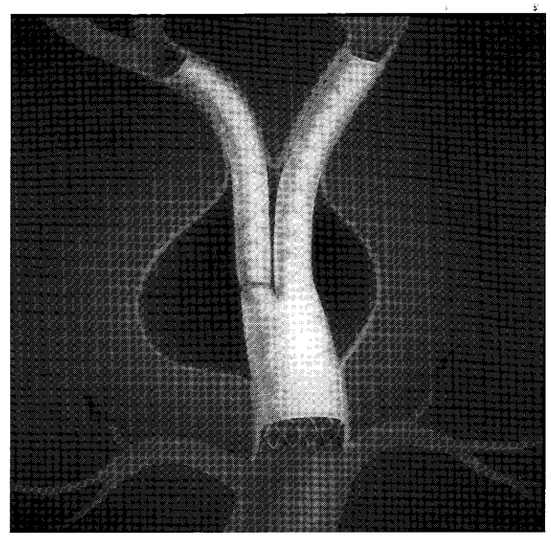
Anesthetic

A general anaesthetic was used for Mr. A. Routine monitors, BP, 5 lead ECG, temperature probe and pulse oximeter, were applied. An arterial line and a CVP were inserted to monitor hemodynamic stability. A foley catheter was inserted to monitor urine output. Mr. A.'s automatic pacemaker/defibrillator was turned off during the procedure and external pacing pads were applied. The defibrillator/external pacing machine remained in the room during the procedure.

Positioning, Prepping and Draping

Mr. A. was placed in the supine position on the radiolucent table, with a long ruler containing radiopaque markers under the back and slightly to the right of the spine. The ruler was used to determine the patient's position in comparison with the imaging equipment. Pressure points were padded, and the ESU pad was placed.

The betadine prep extended from above the nipple line to mid thigh. Draping consisted of a standard square draping with a green towel covering the groin. The extensive prep and draping was performed as a precaution in the event of converting to an open abdominal procedure.



Bifurcated Prothesis in place.

Endovascular Prosthesis Procedure

The endovascular prosthesis used was a 22 x 12 x 165 mm bifurcated graft with a left iliac extension of 12 x 60 mm. The iliac extension is the second leg of the prosthesis which is inserted into the stump of the aortic graft. All personnel in the procedure room must wear lead aprons and thyroid collars for protection against radiation exposure. The personnel involved in the procedure included the vascular surgeon and Fellow, two radiologists, an anaesthetist and RT, a circulating and scrub nurse, the radiology nurse. The placement of the bifurcated endovascular prosthesis proceeded as follows:

1. The vascular surgeon performed the femoral arteriotomy while the radiologist prepared the introducer system by immersing it in iced saline slush. The radiologist performed the placement of the introducer system and prosthesis.

2. The introducer system was inserted over a guidewire to the level of the renal arteries.

3. The prosthesis was released from the introducer system. The nitinol wire stent of the prosthesis expands and becomes rigid when exposed to body temperature. The balloon portion of the introducer was inflated to mould the aortic and iliac segments to the aortic wall, and allow the anchoring barbs to adhere to the aortic wall. The introducer system was removed.

4. On the opposite limb, a femoral arteriotomy was performed to pass a second introducer system into the stump of the aortic bifurcated graft.

5. The iliac limb prosthesis was placed; the balloon of the introducer was inflated to provide a seal with the aortic prosthesis.

6. An angiogram was performed to ensure that the aneurysm was completely occluded. Once this was confirmed, all guidewires and sheaths were removed.

7. Both femoral arteriotomy sites were closed. Standard dressings were applied. *(Meadox Medicals, Inc., 1997)*

The total procedure time, including anaesthetic induction and emergence, was 4 hours 40 minutes. The estimated blood loss was 150 ml. The right femoral artery was clamped for a total of two hours. Mr. A. was extubated prior to the transfer to ICU.

Potential intraoperative complications associated with the endovascular prosthesis include:

- intraoperative rupture of the AAA;
- inadvertent perforation of the artery wall with the guidewire or catheter;
- thrombosis, either within the catheter or the artery;
- embolism of thrombosis or plaque to the renal arteries, iliac arteries, or lower extremities;
- perforation of the AAA site;
- iliac perforation;
- vascular spasm; and
- hemodynamic instability related to clamping of the femoral artery and increased pressure within the aorta. (Meadox Medicals, Inc., 1997)

Postoperative

During the postoperative phase, Mr. A. was monitored for the following complications that may occur related to the use of an endovascular prothesis:

- hemorrhage related to aneurysm rupture, femoral artery bleeding or the use of heparin;
- embolism;
- paralytic ileus related to compromise in inferior mesenteric blood flow;
- graft occlusion;
- perigraft leakage;
- graft migration;
- continued aneurysm perfusion and enlargement;
- wound infection. (Blum et al., 1997; Meadox Medicals, Inc., 1997)

Upon discharge from the Radiology Special Procedure Room, Mr. A. was transferred to ICU. In ICU, Mr. A. was monitored for his hemodynamic and cardiac status, signs of endovascular prosthesis failure, and the effects of prolonged clamping of the femoral arteries. Prosthesis failure would present as hemodynamic changes, abdominal pain related to bleeding, and renal failure. Lower limb pulses were monitored for signs of thrombus formation, and urine output was evaluated as an indicator of adequate kidney perfusion. Mr. A.'s ICU stay was uneventful.

Mr. A. remained in ICU for 24 hours, then transferred to a surgical unit. His recovery continued to progress rapidly and without incidence. Mr. A. was discharged the following day, approximately 51 hours after his procedure. He was scheduled for his first follow-up appointment two days after discharge. The appointment consisted of a physician visit, a CT scan and abdominal ultrasound to evaluate the position of the graft. The second follow-up was scheduled for two weeks post procedure. At that visit an abdominal ultrasound and CT scan were performed. Mr. A.'s recuperation had been excellent and without incident.

Patient Follow-up

The patient with an endovascular prosthesis will have regular follow-up after discharge for 12 to 18 months. At one, three, six and 12 month periods, the patient will have an abdominal ultrasound, routine flat plate x-ray and a CT scan to evaluate the position of the graft and detect increase size of the aneurysm sac (Meadox Medicals, Inc., 1997). Studies have revealed that the aneurysm sac will decrease in size within 12 months of the procedure (Blum et al., 1997).

Endovascular Prosthesis Outcomes

The endovascular prosthesis is a relatively new procedure and technology. Long term outcomes of the procedure are currently being researched. One study involving straight and bifurcated grafts for infra-renal AAA reports a success rate of 87% (n=l 54). Success was defined as "complete exclusion of the abdominal aortic aneurysm from the circulation, with restoration of normal blood flow" (Blum et al., 1997). Minor complications (embolism, femoral artery damage, groin hematoma, graft occlusion and renal insufficiency) were reported at 8%. Major complications (rupture of the iliac artery, embolic graft occlusion requiring amputation of the foot, acute hepatic failure) were reported at 2%. The periopertive mortality rate was 0. 6%. Other reported complications include minor persistent leaks and graft migration. This study reported patient data obtained for a 26 month period (Blum et al., 1997).

Conclusion

Use of the endovascular prosthesis may prove to be an effective alternative to major abdominal repair of aortic aneurysms. This would be beneficial to those patients who are classified at high risk for major abdominal surgery. Although the current research has presented the endovascular prosthesis as a feasible, safe technique (Blum et al., 1997), the results are based on a limited follow-up period. Further research into the effectiveness of the endovascular prosthesis and long term implications needs to be conducted. As well, case costing of the endovascular prosthesis compared to conventional surgery needs to be completed, to demonstrate the cost effectiveness of either technique. ■

References

Blum, U., et al. (1997). Endoluminal stent-grafts for infrarenal abdominal aortic aneurysms. *The New England Journal of Medicine.* 336(2), 13-20.

Fellows, E. (1995). Abdominal aortic aneurysm: Warning flags to watch for. *American Journal of Nursing.* May, 26-33.

Hatswell, E.M. (1994). Abdominal aortic aneurysm surgery, part I: An overview and discussion of immediate perioperative complications. *Heart & Lung* 23(3), 228-240.

Hatswell, E.M. (1994). Abdominal aortic aneurysm surgery, part II: Major complications and nursing implications. *Heart & Lung* 23(4), 337-343.

Meadox Medicals, Inc. (1997). Product Overview.

Meeker, M.H. & Rothrock, J.C. (1995). Alexander's Care of the Patient in Surgery (10th ed). St. Louis: Mosby.

(Photographs courtesy of Boston Scientific Ltd.)

Shortage of RNs expected in early part of new century

A shortage of registered nurses is expected early in the new century, a recent study shows.

Canadian Nurses Association (CNA), in releasing the study in early November, warned there may be a need for as many as 113,000 more nurses to deal with an aging population by the year 2011.

Exodus of nurses

The CNA met with Health Minister Allan Rock to seek the federal government's help in stemming the exodus of nurses out of the country and in attracting more male and younger recruits to the profession.

The CNA, which represents over 275,000 nurses in Canada, acknowledged that the looming shortage may appear bizarre in light of the number of hospital closures. However, Dr. Mary Allen Jeans, Executive Director of the CNA said that, although there is a current glut, many Canadian nurses are all heading for retirement around the same time.

"It may seem like a long time," Jeans explained, "but it means that when your five-year-old is 20, that will be the situation."

Reasons for shortage

The association mentioned four key reasons for the impending shortage:

- Aging nurses - The current nurses' workforce means there are five times as many nurses between 45 and 54 years of age than in 1967;
- Fewer student nurses - Fewer young people are entering the profession, with recruiting largely limited to females;
- Population increase - The Canadian population, according to Statistics Canada, will increase 20% by 2011;
- Population aging - Canada's aging population will need more health care.

Dr. Jeans also released figures showing that 6000 Canadian-trained nurses are now working in the United States, up from 2000 RNs in 1994. ■