



# Clinical Practice Column

## Society for Vascular Nursing (SVN)

# 2009 Clinical Practice Guideline for Patients Undergoing Endovascular Repair of Abdominal Aortic Aneurysms (AAA)

SVN Task Force for Clinical Practice Guideline

### SVN TASK FORCE FOR CLINICAL PRACTICE GUIDELINE

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### TABLE OF CONTENTS

<b>Purpose and Scope</b>	page 49
<b>Definition of Terms</b>	page 49
<b>Preoperative Care</b>	
Assessment:	pages 50-52, 60
Diagnostic Studies:	pages 52-53
Testing:	pages 53-56, 60
Medications:	pages 53, 56-58, 61
Interventions:	page 59
Anesthesia:	pages 59-60
Education:	pages 60-61
<b>Intraoperative Care</b>	
Assessment:	page 61
Medications:	page 61
Interventions:	page 61
<b>Postoperative Care</b>	
Assessment:	page 61
Diagnostic Studies:	pages 62-63
Medications:	page 62
Interventions:	page 62
Education:	pages 62-63
<b>Discharge</b>	pages 62-63

## **Abdominal Aortic Aneurysm Clinical Practice Guideline-Endovascular Repair**

This evidence based clinical practice guideline was developed by the Society for Vascular Nursing (SVN) who is the authority on nursing care of patients with vascular disease. This document needs to be reviewed and revised prior to implementation at appropriate facilities based on the needs of the practice setting and the values and preferences of the patient.

The SVN Task Force for Clinical Practice Guidelines (CPG) was established as a group of experts to draft this guideline based on the latest available evidence.

### **Purpose and Scope**

The purpose and scope of the CPG for Endovascular Repair of Abdominal Aortic Aneurysm is to:

- Improve outcomes for patients undergoing endovascular repair of abdominal aortic aneurysms
- Ensure continuity of care across this population

### **DEFINITION OF TERMS**

**Abdominal Aortic Aneurysm (AAA)** Permanent localized dilation of aorta resulting in at least a 50% increase in diameter compared to the normal expected diameter at the same anatomic level; degenerative process often attributed to atherosclerosis; considered to be present when the diameter reaches 3.0cm. Other causes include infection, arteritis, trauma, inherited connective tissue disorder and anastomotic disruption. Smoking is the most strongly associated risk factor. Natural history is to gradually enlarge and eventually rupture. Women have slightly smaller normal aortic diameters than men. Prevalence is greater in men, however specific risk factors, such as smoking increase the likelihood of aneurysm disease in women.

#### Definitions

1. **Infrarenal neck**- length of normal caliber aorta distal to the renal arteries before the aneurysm
2. **Suprarenal AAA** - encompasses the visceral aortic segment containing the superior mesenteric and celiac arteries (type IV thoracoabdominal aneurysms if aneurysm extends upward to crus of diaphragm)
3. **Juxtarenal AAA**- infrarenal abdominal aorta adjacent to or including the lower margins of renal artery origin
4. **Endovascular**- transfemoral catheter based repair with stent graft
5. **Endoleak**- leakage of blood into the aneurysm sac following endovascular AAA repair:
  - Type I occurs at the proximal or distal anastomosis
  - Type II occurs as a result of collateral flow from branch vessels such as lumbar or mesenteric arteries
  - Type III occurs as a result of tears or defects in the graft material or between the modular components of the graft
  - Type IV leaks occur through pores in the graft fabric

6. **Endotension**- excluded sac continues to enlarge and appears to remain pressurized without evidence of endoleak
7. **Pseudoaneurysm**- pulsatile hematoma at groin access site that forms when puncture site fails to seal and arterial blood jets into the surrounding tissue, does not involve all three layers of the artery wall.
8. **Accessory renal arteries**- an extra renal artery present in up to 30% of the population. Exclusion by endograft repair may result in partial renal infarct
9. **Femoral artery diameter**- minimal 8 mm size usually required for device access and implantation.
10. **A/V fistula**- or arteriovenous fistula is an abnormal connection or passageway between an artery and a vein. It may be congenital, surgically created for hemodialysis treatments, or acquired due to pathologic process, such as trauma or erosion of an arterial aneurysm.
11. **Bruit**- an audible sound associated with turbulent blood flow created by a change in the diameter of the arterial lumen. A bruit usually signifies arterial stenosis at or proximal to the site of auscultation. A tight or nearly occluded artery may not produce a bruit.
12. **Hostile abdomen**- history of multiple abdominal surgeries or infection, resulting in scar tissue or adhesions.

#### **Reference sources:**

1. Greenhalgh RM, Powell JT. Endovascular repair of abdominal aortic aneurysm; *N Engl J Med* 2008; 358:494-501.
2. Pearce W, Peterson B. Abdominal aortic aneurysm {Internet}. Northwestern University School of Medicine; 2007 Dec17 {updated 2008 Dec 15}. {cited 2009 Jan 15}. Available from <http://emedicine.medscape.com/article/463354-overview>.
3. Chaer RA, DeRubertis BG, Trocciola S, et al. Characterization of endoleak following endovascular repair of abdominal aortic aneurysms. *Vascular and endovascular surgery* 41(2):97-105, 2007.
4. Hirsch AT, Haskal ZJ, Hertzner NR, et al. ACC/AHA 2005 Practice Guidelines for the Management of Patients With Peripheral Arterial Disease (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic) A Collaborative Report from the American Association for Vascular Surgery/Society for Vascular Surgery,\* Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients With Peripheral Arterial Disease) Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. *Circulation* 2006; 113: e463-e654.

## Considerations for Endovascular Repair of AAA

- A. Most AAAs cause no symptoms. Surgical selection criteria rely on careful assessment of factors that influence rupture risk, operative mortality and life expectancy. In general:
- Evidence suggests that abdominal aortic aneurysm in women may grow at a faster rate and may rupture at a smaller size (4.5-5.0 cm). This may explain why women have a higher rupture rate and mortality (3 times higher) than men
  - 5cm AAA warrants repair in good risk patient
  - AAA transverse diameter is best predictor of rupture risk; the bigger the aneurysm, the more likely it is to rupture
  - Selective repair recommended in patients with AAA expansion  $\geq 1$  cm/yr
  - Symptoms suggesting acute AAA growth: pain typically steady, lasting for hours to days at a time, gnawing quality, located in the hypogastrium or the lower part of the back, not affected by movement
- B. Specific anatomical requirements:
- Adequate length of normal aorta below the renal arteries for device attachment
  - Shape and angulation of the neck of the AAA; does not preclude adequate device fixation
  - Diameter of the iliac arteries; to allow catheter and device access
  - Length and condition of distal iliac arteries; adequate length, minimal calcification and tortuosity
- C. Advantages:
- Associated with lower short-term rates of death and complications
  - Decreased mortality especially among the elderly population
  - Avoid major transabdominal procedure that may be high risk for patients who have severe cardiopulmonary disease, advanced age, morbid obesity, or hostile abdomen
  - Decreased length of hospital stay
- D. Disadvantages:
- Renal complications related to contrast dye or graft-related ischemia
  - Proximal or distal attachment failure or graft migration
  - Endoleak

### Class I recommendation for prevention rupture risk:

Periodic long-term surveillance imaging should be performed to monitor for an endoleak, to document shrinkage or stability of the excluded aneurysm sac, and to determine the need for further intervention in patients who have undergone endovascular repair of infrarenal aortic and/or iliac aneurysms.

Subsequent aneurysm related procedures-angiography, duplex, CT scanning, and MR angiogram.

### References:

1. Rutherford R, Krupski W. Current status of open versus endovascular stent graft repair of

- abdominal aortic aneurysm. *J Vasc Surg* 2004; 39:1129-39.
2. Dillavou, ED, Muluk SC, Makaroun MS. Improving aneurysm-related outcomes: Nationwide benefits of endovascular repair. *J Vasc surg* 2006; 43:446-52.
3. Brewster D, Cronenwett J, Hallett J, et al. Guidelines for the treatment of abdominal aortic aneurysms; *J Vasc Surgery* 2003;37;1106-17.
4. Schermerhorn ML, O'Malley J, Jhaveri A, et al. Endovascular vs. open repair of abdominal aortic aneurysms in the Medicare population. *N Engl J Med* 2008; 358:464-74.
5. Pearce WM, Peterson B. 2007.
6. Greenhalgh RM, Powell JT. Endovascular repair of abdominal aortic aneurysm; *N Engl J Med* 2008; 358; 494-501
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8. Brady AR, Brown LC, et al. Long-term outcomes of immediate repair compared with surveillance of small abdominal aortic aneurysms. *N Eng J Med* 2002. 346(19): 1445-52.
9. Mohler III ER, Fairman RM. Natural history and management of abdominal aortic aneurysm. {UpToDate}. {updated 2008 July 31; cited 2009 May 14}. Available from <http://www.uptodate.com/patients/content/topic.do?topicKey=~66y6a2VXwiWzFWC>

### *I Patient Assessment.*

#### A. History comprehensive

1. Patient description of symptoms to include the frequency and detail of events.
  - a. Headache, dizziness, vertigo, ataxia/imbalance, decrease level of consciousness (LOC), confusion, memory loss or aphasia/dysarthria, dysphagia, unilateral paresis, visual disturbances, amaurosis fugax, numbness/tingling, face/neck swelling.
  - b. Abdominal or back pain.
  - c. Claudication or rest pain.

### References:

1. AORN. Preoperative patient care in the ambulatory setting. Practice advisory for preanesthesia evaluation- A report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. *Anesthesiology* 2002; 96(2), 485-496.
2. Morasch M, Pearce WH. Extracranial cerebrovascular disease. In: Fahey, VA editor. *Vascular nursing*. 4th ed. St. Louis: Saunders;2004. p. 287-310.
3. Judge NL. Neurovascular assessment. *Nursing Standard* 2007;21(45):39-44.
4. Altizer L. Neurovascular assessment, *Orthopedic Nursing* 2002;21(4); 48-50.

5. ACC/AHA. Guideline Update for Perioperative Cardiovascular Evaluation for Non-cardiac Surgery-Executive Summary. *J Am Coll Cardiol* 2002; 39(3).
2. Identify any risk factors (e.g. diabetes, obesity, substance abuse, previous vascular procedure, dyslipidemia, tobacco use, hypertension, hypercoagulable state, renal disease, patient/family history of stroke or heart disease) and pre-existing comorbidities, particularly a cardiac history as these patients are pre-disposed to a cardiac event.

**References:**

1. Paciaroni M, Caso V, Acciarresi M, et al. Management of asymptomatic carotid stenosis in patients undergoing general and vascular surgical procedures. *J of Neurol Neurosurg and Psychiatry* 2005;75:1332-36.
2. Knoflach M, Kiechl S, Penz D, et al. Cardiovascular risk factors and atherosclerosis in young women. Atherosclerosis risk factors in female youngsters. *Stroke* 2009;40:00-00.
3. Dzau V, Antman E, Black H, et al. The cardiovascular disease continuum validated: Clinical evidence of improved patient outcomes Part I: Pathophysiology and clinical trial evidence (risk factors through stable coronary artery disease). *Circulation* 2006 Dec; 114:2850-70.

**B. Physical exam:**

Neurovascular assessment to establish neurovascular baseline consider the five P's pulse, pallor, paresthesia, paralysis, pain; check bilateral extremities and compare for strength and equality; use your same hand for patient assessment; check radial, femoral, popliteal, dorsalis pedis, posterior tibial pulses; check lower extremity motor strength and movement, temperature, color, sensation, and capillary refill.

1. Inspection
  - a. Observe for pulsatile abdominal mass.
  - b. Look for visceral or inguinal hernias.
  - c. Observe color of extremities; compare bilaterally.
2. Auscultation
  - a. Evaluate the abdominal aorta, renal, iliac and femoral arteries for the presence of bruit.

**References:**

1. Bickley L, Szilagvi P. In: *Bates' Guide to Physical Exam, The Abdomen*; Chapter 9; Lippincott Williams And Wilkins 2003.
2. Pearce, WM, Peterson, B. 2007.
3. Benjamin M, Dean RH. *Vascular assessment. Current diagnosis and treatment in vascular surgery.* Norwalk, CN: Appleton & Lange, 1995.
- b. Check bilateral upper extremity blood pressures. Hypertension may trigger an evaluation for renal artery stenosis. Unequal upper extremity blood pressures

(>30mmHg difference in systolic blood pressure [SBP]) may indicate subclavian artery stenosis in the arm with the lower SBP.

**References:**

1. Morasch M, Pearce WH. 2004.
2. Pearce WM, Peterson, B. 2007.
- c. Heart and pulmonary assessment: auscultate heart sounds, count radial and apical pulse, auscultate lung sounds anterior and posterior, document respiratory rate and effort, percussion of chest.

**References:**

1. Morasch M, Pearce WH. 2004.
3. Palpation:
  - a. The abdominal exam includes palpation of the aorta and estimating the aortic diameter. Most clinically significant abdominal aneurysms are palpable. However, the sensitivity of palpating for abdominal aneurysms depends on the examiner's experience, the patient's body habitus and the size of the aneurysm. Assess for abdominal tenderness or any palpable or pulsatile masses. If a thrill is palpated in the abdomen, this could indicate rare finding of an aortocaval fistula.
  - b. Palpate for femoral and popliteal artery aneurysms.
  - c. Palpate peripheral pulses bilaterally-radial, brachial, femoral, popliteal, posterior tibial, dorsalis pedis, Document according to 0=absent, 1=diminished, 2=normal, 3=bounding.
  - d. Rectal exam to palpate for any masses and to guaiac stool. Positive guaiac stool may indicate the presence of colon cancer.

**References:**

1. Shimanda Y, Sogowa M, Okada A, et al. A single stage operation for AAA with concomitant colorectal carcinoma. *Ann Thorac Cardiovascular Surgery*, 11(5):339-342.
2. Peitzman AB, Rhodes M, Schwab CW, et al. *The trauma manual: trauma and acute care surgery*, 2007. p. 580.
3. Hirsch AT, Haskel ZJ, Hertzner NR, et al. 2006.
4. Perform Ankle-Brachial Index (ABI)  
Peripheral Arterial Disease (PAD) can be easily diagnosed through measurement of the ratio of the systolic blood pressure in the ankle to that in the arm; the ankle brachial index or ABI.

**Ratio**

Normal	1.00-0.95
Mildly abnormal	0.95-0.80
Claudicant	0.80-0.40
Ischemic	<0.40

ABI is a simple, inexpensive, non-invasive test that can be easily performed in most clinical settings and has a sensitivity of 79-95% and a specificity of 95 to 100%.

- No patient prep
- Ankle/brachial pressure

**References:**

1. Hirsch AT, Haskal ZJ, Hertzler NR, et al. 2006.
2. Blackburn D, Peterson-Kennedy L. Noninvasive vascular testing. In: Fahey VA, editor. *Vascular nursing*, (4<sup>th</sup> ed.); St. Louis: Saunders; 2004. p.73-95.

**C. Imaging Studies:**

**1. Abdominal Duplex**

Non-invasive abdominal ultrasound utilizing a low-frequency transducer, usually 3 MHz to examine the deep abdominal vessels. Size and location of the aneurysm can be determined. After endovascular repair flow in the graft is assessed. The aneurysm sac size is measured and should shrink over time after graft placement. Leaks into the lumen of the aorta can be detected.

Patient prep:

- NPO 3-4 hours prior to study
- Best done early in the day
- Should take cardiac medications with sip of water

**References:**

1. Hirsch AT, Haskal ZJ, Hertzler NR, et al. 2006.
2. Blackburn D, Peterson-Kennedy L. 2004
3. Solomon J, Baum R, Fairman RM, et al. Aortic stent grafts for abdominal aortic aneurysms. In: Rose BD, editor. *Up to date in medicine*. Boston, MA: Up To Date Inc., 2000.
4. Benjamin M, Dean, RH. 1995.

**2. Carotid Duplex**

Non-invasive study utilizing Doppler waveforms and color flow imaging to identify blood flow in the carotid and vertebral arteries.

- No patient prep

**References:**

1. Wardlaw JM, Chappell FM., et al. NHS Research and Development Health Technology Assessment Carotid Stenosis Imaging Group. Non-invasive imaging compared with intra-arterial angiography in the diagnosis of symptomatic carotid stenosis: a meta-analysis. *The Lancet* {Internet}, 2006 May 6 {cited 2008 Nov 15}; 367 (9521):1503-1512. Available from: [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(06\)68650-9/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(06)68650-9/abstract)

**3. Computed Tomography Angiogram (CTA)**

Imaging study utilizing non-contrast and IV contrast to identify specific anatomy of the aneurysm, normal aorta, renal, visceral and iliac arteries. Vital measurements for endograft repair are defined with three-dimensional

reconstruction views and spiral imaging. Measurements are determined for appropriate size and configuration of the endograft.

Patient prep:

- NPO 4 hours prior to exam
- Glomerular Filtration Rate (GFR), BUN, creatinine levels to assess renal function
- Pre-medication for dye/contrast media allergy- (refer to section D, page 54)
- Pre-medication for renal insufficiency- (refer to section D, page 54)

**References:**

1. Hirsch AT, Haskal ZJ, Hertzler NR, et al. 2006.
2. Solomon et al. 2000.

**4. Magnetic resonance angiography (MRA)**

Imaging study utilizing non-iodinated contrast medium to generate images of blood vessels with the capability of producing high-resolution three-dimensional images. The Hirsch et al (2006) guidelines note that MRA may be a suitable alternative to CTA. The decision to use either is location-specific due to operator proficiency and the availability of the appropriate equipment.

Patient prep:

- NPO 4 hours prior to exam
- GFR, BUN, creatinine
- Pre-medication for renal insufficiency (refer to section D, page 54)

**References:**

1. Hirsch et al. 2006. ACC/AHA Practice.
2. Greenhalgh RM, Powell JT. 2008.
3. Solomon et al. 2007.

**5. Contrast angiography**

Blood vessel imaging after injection of iodinated contrast material. Utilized to clarify extent of aneurysm, its relation to major aortic branches, presence and severity of branch vessel aneurysmal or occlusive disease, measurement of aneurysm neck and iliac vessels to define anatomical appropriateness for endovascular repair. Angiography images the inner lumen of the aorta and not the wall of the aorta and cannot evaluate the true lumen diameter, extent of the thrombus, plaque and calcification.

Patient prep:

- NPO 8 hours prior to procedure
- Patient should take cardiac medications with sip of water on morning of procedure
- Pre-procedure history and physical
- Laboratory evaluation: BUN, creatinine, PT, PTT, INR, platelet count, hemoglobin, and hematocrit
- Puncture site prep: femoral or brachial artery cannulation
- Intravenous hydration
- May include: modification of diabetes or anticoagulant medications, anticoagulant medications, allergenic

contrast reaction pre-medication, renal protective medication, pre-procedure analgesic

Post-procedure:

- Hemostasis of puncture site via manual compression 20-30 minutes after catheter removal
- Monitored bedrest 4-6 hours with assessment of heart rate, blood pressure, pulse checks of access extremity, wound site assessment for bleeding, pseudoaneurysm, or hematoma

#### References:

1. Allie DE, Smalling R, Hebert RT, et al. The costs of VAM complications. *Endovasc Today*. 2006;5:21-28.
2. Innovations Report {Internet}. 3D MDCT can replace conventional angiography of extremities c2004 Jan 7. {cited 2008 Nov 15}. Available at: [http://www.innovations-report.com/html/reports/medicine\\_health/report-30809.html](http://www.innovations-report.com/html/reports/medicine_health/report-30809.html).
3. Ota H, Takaso K, Igarashi K, et al. MDCT compared with digital subtraction angiography for assessment of lower extremity arterial occlusive disease. *Am J Roentgenol* 2001; 182: 201-9.

#### D. Prep Medications:

Purpose-Prevention of contrast induced nephrotoxicity or allergic reactions with contrast administration:

1. Impaired renal function- defined as serum creatinine level >1.5mg/dL or creatinine clearance <40ml/min. Increased rates of adverse events are generally seen below an estimated glomerular filtration rate (GFR) of 60mL/min/1.73 m<sup>2</sup>. Many laboratories can run a GFR along with a BUN/creatinine. Additionally, the National Kidney Foundation provides free access to the MDRD (Modified Diet and Renal Disease) calculator. Web-link to this calculator is: [www.kidney.org/professionals/KDOQI/gfr\\_calculator.cfm](http://www.kidney.org/professionals/KDOQI/gfr_calculator.cfm).
  - a. Mucomyst (N-acetylcysteine): 600mg tablets or (20% solution) 3 cc dose BID day before the procedure and day of the procedure. Recent data show some benefit with higher doses of 1200 mg BID day before and day of procedure.
  - b. NaHCO<sub>3</sub> (8.4%) 3 amps in 1 liter NS or D<sub>5</sub>W IV fluid to be initiated one hour prior to procedure, or until liter is infused and 3ml/kg/hr and up to 6 hours post procedure at 1ml/kg/hr. In patients with heart failure history, rate of administration may be decreased.
2. Diabetic patients on metformin: American College of Radiology recommends discontinuing or holding 24 hours before procedure and resume in 48 hours or when creatinine level post procedure < 1.5mg/dL. A repeat serum creatinine is optional if patient has multiple comorbidities. It is usually not necessary if baseline renal function is normal.

3. Diuretic medications to be held day of procedure to prevent dehydration which may intensify effect of contrast on kidneys.
4. Iodine or shell fish allergy.
  - a. Prednisone 50mg BID. day before procedure and morning of the procedure.
  - b. Benadryl 50mg oral one hour prior to procedure.
5. Intravenous hydration most effective preventive measure: D<sub>5</sub>Normal saline solution (may vary according to facility) administered at 1mL/kg over 8-12 hours prior to the procedure and 4 hours after the procedure.

#### References:

1. Hirsch AT, Haskal ZJ, Hertzler NR et al. 2006.
2. Thompson E, King S. Acetylcysteine and fenoldopam: Promising new approaches for preventing effects of contrast nephrotoxicity. *Crit Care Nurse* 2003; 23(3):39-46.
3. Merten GJ, Burgess WP, Gray LV, et al. Prevention of contrast-induced nephropathy with sodium bicarbonate: A randomized controlled trial. *JAMA* 2004; 291(19):2328-34.
4. Bui K, Horner J, Herts B, et al. Intravenous iodinated contrast agents: Risks and problematic situations. *Cleve Clin J of Medicine* 2007; 74(5):361-367.
5. Barr LF, Kolodner K. N-acetylcysteine and fenoldopam protect the renal function of patients with chronic renal insufficiency undergoing cardiac surgery. *Crit Care Med* 2008; 36(5):1427-35.
6. American College of Radiology, Version 6, 2008; Contrast media administration guidelines {Internet}. Accessed 2009 Jan 15. Available at: <http://www.scribd.com/doc/2952016/Contrast-Media-Administration-Guidelines-by-the-ACR-American-College-of-Radiology-Version-6-2008>
7. Simpson AK, Levy N, Hall GM. Perioperative IV fluids in diabetic patients-don't forget the salt. *Anesthesia*, 2008 Oct; 63(10):1043-5.
8. GFR Calculator: Retrieved from The National Kidney Foundation {cited 2009 Feb 3}. Available at: <http://www.kidney.org/professionals/KLS/gfr.cfm>
9. Solomon R, Deray G on behalf of Consensus Panel for Contrast-induced Nephropathy. How to prevent contrast-induced nephropathy and manage risk patients: Practical recommendations. *Kidney International* 2006; 69:S51-S53.

#### E. Testing

1. Complete Blood Count (done to assess the need for blood transfusions, to assess platelet count and possible infection) Although anemia is present in only 1% of asymptomatic patients, preoperative hemoglobin levels predict postoperative mortality (Hgb >12g/dl was 1.3%, while Hgb <6g/dl was 33.3%).

**Reference:**

1. Carson JL, Duff A, Poses RM, et al. Effect of anemia and cardiovascular disease on surgical mortality and morbidity. *Lancet* 1996; 348:1055.
2. Type & Crossmatch- done to prepare for the possibility of transfusion and to assess for antibodies.
3. Blood Chemistries- to include liver and renal panels; to determine integrity of renal and liver function and to assess operative risk.

**Renal Insufficiency**- (e.g. GFR <60) - the incidence of renal insufficiency increases with age and is an independent risk factor for postoperative cardiac complications. Renal insufficiency is an independent risk factor for postoperative pulmonary complications.

**Liver Enzyme**- abnormalities are uncommon (0.1%); however, severe liver enzyme abnormalities are associated with increased surgical morbidity and mortality.

**Blood Glucose**- The frequency of abnormal glucose levels increase with age. Patients with insulin-dependent diabetes and hyperglycemia have increased morbidity (particularly cardiac complications) and mortality following vascular surgery.

**References:**

1. Kaplan EB, Sheiner LB, Boeckmann AJ, et al. The usefulness of preoperative laboratory screening. *JAMA*, 1985; 253(24): 3576-81.
  2. Macpherson DS. Preoperative laboratory testing: Should any "tests" be routine before surgery? *Med. Clinic of N. Am* 1993;77:289.
  3. Smentana GW, Lawrence VA, Cornell JE. Preoperative pulmonary risk stratification for noncardiothoracic surgery: systematic review for the American college of physicians. *Ann Intern Med* 2006; 144:581
  4. Suchman AL, Mushlin AI. How well does the activated partial thromboplastin time predict postoperative hemorrhage? *JAMA* 1986; 256(6): 750-3.
  5. Velanovich V. The value of routine preoperative laboratory testing in predicting postoperative complications: a multivariate analysis. *Surgery* 1991; 109(3):236-46.
  6. Romero L, de Virgilio C. Preoperative Cardiac Risk Assessment An Updated Approach. *Arch Surg*. 2001;136:1370-1376.
  7. Huggins TL, Estafanous FG, Loop FD, et al. Stratification of morbidity and mortality outcome by preoperative risk factors in coronary artery bypass patients. A clinical severity score. *JAMA* 1992 May; 267(17):2344-8. Erratum in: *JAMA* 1992 Oct 14; 268(14): 1860.
4. Fasting lipid panel- assess need for cholesterol-lowering medications and dose.

**References:**

1. New Zealand Guidelines Group. Evidence-based best practice guideline: the assessment and management of cardiovascular risk. Wellington, New Zealand: New Zealand Guidelines Group, 2003: {cited 2008 Nov 15}.190-226. Available at: [www.nzgg.org.nz/guidelines/dsp\\_guideline\\_popup.cfm?guidelineID=35](http://www.nzgg.org.nz/guidelines/dsp_guideline_popup.cfm?guidelineID=35)
  2. Albers SW, Hart, RG, Lutsep HL, et al. AHA Scientific statement. Supplement to the guidelines for the management of transient ischemic attacks: a statement from the ad hoc committee on guidelines for the management of transient ischemic attacks. Stroke Council, American Heart Association. *Stroke*, 1999; 30: 2502-11.
5. Coagulation Studies (PT, PTT, INR)  
Abnormalities of the Prothrombin Time (PT) or Partial Thromboplastin Time (PTT) are uncommon. If an abnormality is present, the perioperative risk of hemorrhage is poorly defined, particularly in patients thought low risk for hemorrhage based on history and physical exam.

**References:**

1. Kaplan EB, Sheiner LB, Boeckmann AJ, et al. The usefulness of preoperative laboratory screening. *JAMA*. 1985; 253(24): 3576-8.
  2. Bushick JB, Eisenbert JM, Kinman K, et al. Preoperative medical evaluation of the healthy patient. *J. Gen Intern Med* 1989; 4:493.
  3. Sie P, Steib A. *Can J. Anaesth* 2006 June; 53(6 suppl):S12-20.
6. Urinalysis (UA)- should be done to assess unsuspected renal disease and for infection (urinary tract infection-UTI) to prevent possible contamination of synthetic material used during procedure. However, the relationship between UTI and surgical infection is unclear. Additionally, if serum creatinine is done preoperatively, UA is not necessary to assess renal function. Routine UA is not recommended routinely preoperatively unless there is a suspicion for a UTI.  
Testing preoperatively, however, is not supported by available research.

**References:**

1. Lawrence VA, Kroenke K. The unproven utility of preoperative urinalysis. *Clinical use. Arch Intern Med* 1988; 148(6):1370-3.
2. Lawrence VA, Gafni A, Gross M. The unproven utility of the preoperative urinalysis: Economic evaluation. *J. Clin Epidemiol* 1989; 42:1185. {cited 2008 Nov 15}. Available at: <http://www.emedicine.com/article/285191-overview>

7. **Chest X-ray** (CXR-both PA and lateral)-provides preliminary assessment of the status of the heart and lungs. The relationship between the findings on preoperative CXR and perioperative morbidity is not well defined. Thus routine preoperative CXR are not recommended unless the patient is over 60 yrs, or has pulmonary or cardiac disease.

**References:**

1. Smentana GW, Lawrence VA, Cornell JE. 2006.
  2. Archer C, Levy AR & McGregor M. Can J. Value of routine preoperative chest x-rays: a meta-analysis. *Anesth* 1993; 40(11): 1022-7.
8. **EKG**- provides a baseline to assess cardiac rhythm, ischemia, hypertrophy, and prior infarction.

12-Lead EKG:

- Recommended for patients with at least one **Clinical Risk Factor**:
  1. ischemic heart disease such as unstable angina, atrial or ventricular arrhythmias.
  2. history of compensated heart failure (such as LVEF <30%, NYHCIII-IV).
  3. cerebrovascular disease.
  4. diabetes mellitus.
  5. renal insufficiency who are undergoing vascular procedures.
- Recommended for patients with known coronary artery disease, peripheral arterial disease, diabetes or renal insufficiency (such as GFR < 60)
- Recommended for patients with:
  - Coronary artery disease
  - Peripheral arterial disease
  - Diabetes
  - Renal insufficiency
  - Men > 45 yrs, Women > 55 yrs
  - Electrolyte abnormalities
  - Hypertension
  - Patients undergoing major surgery

**References:**

1. Eagle KA, Berger PB, Calkins H, et al. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery: A Report of the American College of Cardiology . ACC/AHA 2007 Guidelines on Surgery: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery. *Circulation*, October 23, 2007; 116(17): e418 - e500.
2. Kaplan EB, Sheiner LB, Boeckmann AJ, et al. 1985.
3. Macpherson DS. 1993.
4. Smentana GW, Lawrence VA, Cornell JE. 2006.

F. **Pulmonary Evaluation**

Pulmonary Function Tests (PFTs) COPD is an independent predictor of operative mortality, therefore pulmonary function should be assessed in patients with a smoking history or chronic obstructive pulmonary disease (COPD) preoperatively to determine operative risk and postoperative care. Patients who are able to climb stairs generally do well without PFTs. If in doubt, check:

- PFTs as needed
- Arterial blood gases as needed
- Smoking cessation- recommended for 8 weeks prior to surgery to decrease incidence of pulmonary complications such as pneumonia or prolonged ventilatory support

**References:**

1. Pearce WM, Peterson B. 2007.
2. Benjamin M, Dean, RH. 1995.
3. Upchurch GR, Proctor MC, Henke P, et al. Predictors of severe morbidity and death after elective abdominal aortic aneurysmectomy in patients with chronic obstructive pulmonary disease. *J Vasc Surg* 2003; 37:594-95.
4. Warner DO. Preoperative smoking cessation: How long is long enough? *Anesthesiology* 2005; 102(5):883-4.

G. **Glucose control**

Diabetes mellitus is also associated with increased risk of perioperative infection and postoperative cardiovascular morbidity and mortality. Elevated (Hb)A1C levels >6.9 (normal 4-5.9%) may also predict a higher rate of postoperative infections. Both general anesthesia and surgery can cause a relative insulin hyposecretion and insulin resistance via release of hormones such as glucocorticoids, growth hormone, catecholamines, and glucagon.

- Uncontrolled diabetes can lead to volume depletion from osmotic diuresis, and life-threatening conditions such as diabetic ketoacidosis (DKA) or nonketotic hyperosmolar state/hyperosmolar hyperglycemic state (HHS)
- Hypoglycemia can possibly induce arrhythmia, other cardiac events, or transient cognitive deficits. Hypoglycemia and neurogluopenia can be difficult to detect in sedated patients postoperatively

1. A1C (diabetics).
2. Fasting blood sugar.

Goals for blood glucose levels in critically ill surgical patients should be kept close to 110 mg/dl and generally <140 mg/dl by utilizing intravenous (IV) insulin protocols. Fasting blood glucose levels of <126 mg/dl and random blood glucose levels <180-200 mg/dl have been associated with improved outcomes. Glycemic goals must be individualized for each patient involving hospital system support and utilization of protocols for hypoglycemia.

**References:**

1. American Diabetes Association. Standards of medical care in diabetes-2007. *Diabetes Care* 2007. 30:S4-S41. {cited 2008 Nov 15}. Available at:



[http://care.diabetesjournals.org/cgi/content/full/30/suppl\\_1/S4](http://care.diabetesjournals.org/cgi/content/full/30/suppl_1/S4).

2. Brandt M, Kehlet H, Binder, C, et al. Effect of epidural analgesia on the glycoregulatory endocrine response to surgery. *Clin Endocrinol (Oxf)* 1976; 5:107.
3. Brandt MR, Kehlet H, Faber O, et al. Hypertension, admission blood pressure and perioperative cardiovascular risk. *Perioperative management of diabetes mellitus Endocrinol* 1979; 6:167.
4. Clarke RS. The hyperglycaemic response to different types of surgery and anaesthesia. *Br J Anaesth* 1970; 42:45-53.
5. Russell RC, Walker CJ, Bloom SR. Hyperglucagonaemia in the surgical patient. *Br Med J* 1975; 1:10-2.
6. Schwartz SS, Horwitz DL, Zehfus B, et al. Use of a glucose controlled insulin infusion system (artificial beta cell) to control diabetes during surgery. *Diabetologia* [Internet]. 1979 March; [cited 2008 Nov 15]; 16(3):157-64. Available from: <http://www.springerlink.com/content/mw61r877r5344146/>
7. Aarimaa M, Slati P, Haapaniemi L, et al. Glucose tolerance and insulin response during and after elective skeletal surgery. *Ann Surg* 1974 June; 179(6):926-9.
8. Wright PD, Henderson K, Johnston I. Glucose utilization and insulin secretion during surgery in man. *Br J Surg* 1974;61:5-8.
9. Mathur R. Hemoglobin a1c test. *MedicineNet.com* [Internet]. 2009 Jan 15 [cited 2009 Jan 15]. Available at: [http://www.medicinenet.com/hemoglobin\\_a1c\\_test/article.htm](http://www.medicinenet.com/hemoglobin_a1c_test/article.htm)
10. American Diabetes Association. American diabetes association clinical practice recommendations 2009. *Diabetes Care* 2009. 34(1):S13-S61. DOI: 10.2337/dc09-S013

#### H. Hypertension (HTN) Management

Hypertension is a known risk factor for a cardiovascular catastrophe in the perioperative period. During the induction of anesthesia, sympathetic activation can cause the blood pressure to rise by 20 to 30 mmHg and the heart rate to increase by 15 to 20 beats per minute in normotensive individuals. The ACC/AHA guidelines list uncontrolled hypertension as a "minor" risk factor for perioperative cardiovascular events.

#### References:

1. Kohlman-Trigoboff D. Hypertension management in patients with vascular disease. *J of Vasc Nursing* 2004. 22(2):53-6.
2. Aronson S, Boisvert D, Lapp W. Isolated systolic hypertension is associated with adverse outcomes from coronary artery bypass grafting surgery. *Anesth Analg* 2002; 94:1079.
3. Howell SJ, Sear YM, Yeates D, et al. *Anesth* 1996; 51:1000.

4. Wolfsthal SD. Is blood pressure control necessary before surgery? *Med Clin North Am* 1993; 77:349.
5. ACC/AHA 2007 guidelines. 2007.

#### I. Cardiac Evaluation

##### Active Cardiac Conditions:

- Unstable angina
  - Heart failure
  - Significant arrhythmias
  - Severe valvular
1. Noninvasive cardiac stress testing is
    - a. Not useful for patients with no **Clinical Risk Factors** undergoing intermediate-risk noncardiac surgery.
    - b. Not recommended for elective noncardiac surgery within 4-6 weeks of bare-metal or drug-eluting coronary stent placement.
    - c. Recommended preoperatively for patients needing vascular surgery who have more **Clinical Risk Factors** (see EKG in Preop Testing Section above) have poor functional capacity (less than 4 metabolic equivalent-(METS), or cannot climb a flight of stairs or walk up a hill without difficulty).
    - d. Recommended for patients with **Active Cardiac Conditions** in whom noncardiac surgery is planned.
      - Cardiology consultation
      - ECG
      - Echocardiogram may be considered
      - Cardiac Stress Test
      - Cardiac Catheterization

#### References:

1. Falcone C. The value of preoperative pharmacologic stress testing before vascular surgery using ACC/AHA Guidelines;2003 Elsevier, Inc.
2. Eagle KA, Berger PB, Calkins H, et al. 2007.
3. Fleisher, L., Beckman, J., Brown, K., et al. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation. [Internet]. *Circulation* 2007 Sept. 27; 116:e418-e500. [cited 2008 Nov 15]. Available at: <http://circ.ahajournals.org>
4. Eagle KA, Brundage BH, Chaitman BR, et al. Guidelines for perioperative cardiovascular evaluation for noncardiac surgery. *Circulation*. 1996 Mar 15; 93(6):1278-317.

#### J. Medications

1. On day of surgery, take morning medications as directed.
  - a. Diabetic Medications:
    - Oral diabetic medications should be withheld on the morning of surgery since the patient will be nothing by mouth (NPO)
    - Diabetics on insulin should inject only HALF of their usual morning dose of NPH, ultralente, or lantus insulin on the morning of surgery UNLESS their morning

blood sugar runs low (< 100), in case they should not inject any insulin on the morning of surgery. No regular, 70/30 or humalog/lispro insulin should be injected by the patient that morning

- Some diabetics use just a single daily dose of NPH, ultralente, or lantus insulin in the evening. For those patients, only the ultralente or lantus dose should be HALF on the evening before surgery, but NPH dose is the SAME due to shorter duration of action

b. Antiplatelets:

- Acetylsalicylic Acid (ASA)-inhibits the enzyme cyclooxygenase, reducing production of thromboxane A<sub>2</sub>, a stimulator for platelet aggregation. This interferes with the formation of thrombi by irreversibly inhibiting platelet aggregation; therefore, reduces the risk of stroke. Stopping ASA therapy in patients with underlying cardiovascular disease for five or more days may increase the risk of stroke or acute coronary syndrome. Those at high risk for perioperative vascular complications when perioperative hemorrhage carries a low morbidity should continue ASA. Significant practice variation exists but there is insufficient data to support the optimal perioperative management of patients taking ASA. It is recommended, however, to stop ASA for three to five days preoperatively thereby stopping the ADP receptor-blocking effect of ASA
- Clopidogrel (Plavix)- a thienopyridine that inhibits ADP binding to platelet receptors- thus decreasing platelet aggregation. Has greater risk reduction in patients with peripheral arterial disease in preventing stroke, MI or vascular death
- Dipyridamole (Persantine)- impairs platelet function by inhibiting the activity of adenosine nucleotides and cyclic AMP. It also causes coronary artery vasodilation. It has greater risk reduction than ASA alone; however, in combination with aspirin (aggrenox, Dipyridamole 200mg/ASA 25mg) the risk for stroke is further reduced compared to ASA or Dipyridamole alone. No data exists regarding the safety of discontinuing dipyridamole in the preoperative period. If the decision is made to stop dipyridamole, it is recommended to be stopped at least two days before surgery. Practitioners often prefer to continue aspirin if dipyridamole is discontinued preoperatively. Aggrenox (dipyridamole with aspirin) should be discontinued seven to ten days preoperatively
- Ticlopidine (Ticlid) a thienopyridine, chemically similar to Clopidogrel. Platelet aggregation inhibitor by inhibiting ADP-induced platelet fibrinogen binding. Not considered first line antiplatelet for stroke prevention because of the side effect and cost. Severe side effects are neutropenia and thrombotic thrombocytopenic purpura (TTP)

**References:**

1. Clegg A. Aspirin Dose and Cardiovascular Disease Prevention. *JAMA* 2007 Aug 8; 298(6); 625-6.
2. Muluk V, Macpherson D. {UpToDate}. Perioperative medication management. {updated 2009 Feb 6; cited 2009 May 14}. Available from:<http://www.uptodate.com/patients/content/topic.do?topicKey=~CCAspYzN1KDTx>
3. Ferraris VA, Ferraris SP, Moliterno DJ, et al. The Society of Thoracic Surgeons practice guideline series: aspirin and other antiplatelet agents during operative coronary revascularization (Executive Summary). *Ann Thorac Surg* 2005; 79:1454-61.
4. American College of Chest Physicians. Antithrombotic and thrombolytic therapy: American college of chest physicians evidence-based clinical practice guidelines. *CHEST* 2008 Oct 23; 133:71S-105S.
5. Caplan RA, Connis RT, Nickinovich DG, et al. Practice alert for perioperative management of patients with coronary stents: A report by the American society of anesthesiologists committee on standards and practice parameters. *Anesthesiology* 2009; 110(1):22-23.
6. Douketis AU, Berger PB, Dunn AS, et al. The perioperative management of antithrombotic therapy: American college of chest physicians evidence-based clinical practice guidelines. 8th ed. *CHEST* 2008 Jun; 133(6Suppl):299S-339s.

c. Beta Blocker:

- Should be continued in patients undergoing surgery who are using beta blockers to treat angina, symptomatic arrhythmias, or hypertension
- Should be given in patients considered high cardiac risk (ischemia noted on preoperative cardiac testing)
- Should be given in patients considered high risk (presence of more than 1 one **Clinical Risk Factor**)
- Should not be used in patients who have an absolute contraindication to beta blockers (e.g. active asthma, bronchospasm history, heart rate < 60 bpm, systolic BP < 90 mm Hg, severe depression, second or third degree heart block or hypersensitivity to beta blockers)

**References:**

1. *JAMA* 2001; 285:1865-73.
  2. Fleisher L, Beckman J, Brown K, et al. 2007.
- d. Coumadin (warfarin): Protocols regarding patients on long term Coumadin therapy pre and post procedure may vary according to the provider and the institution. If not contraindicated the following is recommended.
- Stop 5 days prior to surgery

- Bridging with low molecular weight heparin (LMWH) beginning day of 3 preoperatively, and stopping with last dose LMWH the morning before day of surgery
- Day of procedure, resume Coumadin
- Day after procedure resume LMWH, continue Coumadin
- Day 2 and 4 post procedure check INR
- Stop LMWH when INR reaches and remains >2 for 4 days

#### References:

1. Jackson C. Managing outpatient anticoagulation. Clinician Reviews 2008; 18(2). {cited2008 Nov 15}. Available at: [http://www.clinicianreviews.com/index.asp?show=lesson&page=courses/105688/lesson.htm&lsn\\_id=105688](http://www.clinicianreviews.com/index.asp?show=lesson&page=courses/105688/lesson.htm&lsn_id=105688)
2. Hirsh J, Fuster V, Halperin J, et al. American Heart Association/American College of Cardiology Foundation Scientific Statement. AHA/ACC Foundation guide to Warfarin therapy. Am Coll Cardiol, 2003; 41:1633-52
3. Muluk V, Macpherson D. 2009.
4. Ferraris VA, Ferraris SP, Moliterno DJ, et al. 2005.
5. American College of Chest Physicians. 2008.

#### e. Antibiotics

- The goal of antimicrobial prophylaxis is to eradicate or retard the growth of endogenous microorganisms. The efficacy of antibiotic prophylaxis in clean and clean-contaminated surgery has been clearly established. Patients who receive prophylactic antibiotics within a two hour "window" before the initial incision have lower rates of Surgical Site Infection (SSI) than patients who receive antibiotics either too early or postoperatively
- The antibiotics must be given within 60 minutes of incision, and discontinued within 24 hours from surgery end time. Prophylactic antibiotic selection is consistent with guidelines for surgical patients. Cefazolin or cefuroxime is preferred for cardiothoracic and vascular patients. Vancomycin is preferred for methicillin-resistant Staphylococcus aureus (MRSA); if beta-lactam allergy, vancomycin or clindamycin

#### References:

1. The Joint Commission. Current Specification Manual for National Hospital Quality Measures Surgical Care Improvement Project (SCIP). 2006 July. {cited 2008 Nov 15}. Available at: <http://www.jointcommission.org/PerformanceMeasurement/PerformanceMeasurement/Current+NHQM+Manual.htm>
2. Van Kasteren ME, Mannien J, Ott A, et al. Impact of postdischarge surveillance on surgical site infection. Clin Infect Dis 2007;44: 921.

#### f. Chronic Medications

- Cox II Inhibitors: Traditional NSAIDS such as ibuprofen, naproxen, sulindac, etc., should all be discontinued **at least 3 days** prior to surgery. (Salsalate and Celebrex do NOT need to be discontinued prior to surgery because they do not affect platelets/bleeding.)
- Appetite Suppressant Drugs  
These medications such as phentermine should be discontinued before surgery (advise to stop **two weeks** prior to surgery if time permits). There are many of these medications on the market for weight loss and frequently they have amphetamine-like activity
- Antidepressants
  - Serotonergic antidepressants have been shown to increase bleeding risk for surgery, so these drugs should be held ahead of the procedure. Paxil (paroxetine), Zoloft (sertraline), Effexor (venlafaxine), and Celexa (citalopram) should be discontinued **3 days** prior to surgery. Prozac (fluoxetine) should be stopped for **one week** before surgery, if time permits
  - Monoamine Oxidase Inhibitors (MAOI) are a significant concern for surgery/anesthesia and should be taken at the discretion of the anesthesiologist. These are uncommonly used antidepressants including selegiline transdermal (Esmam), phenelzine (Nardil), tranylcypromine (Parnate), and isocarboxazid (Marplan)
- Nutritional Supplements and Herbal Medications  
Due to bleeding and anesthesia concerns related to herbal supplements, it is advisable that patients simply be instructed to stop all herbal supplements/medications for **two weeks** prior to surgery, if time permits

Herbal medications include, but are not limited to:

Birch Leaf	Kava-Kava
Black Licorice	Kola nut (Kola)
Cascara	Morinda Citrifolia
Echinacea	Melatonin
Ephedra	Nettle
Feverfew	Noni
Garlic	Pau D'Arco
Ginger	Sarsaparilla
Ginko Biloba	St. John's Wort
Ginseng	Saw Palmetto
Goldenseal	Senna
Guarana	Valerian Root
Hawthorn	Vitamin E
Horehound	White Willow
Horse Chestnut	Yerba Mate
Hydrangea	Yohimbe

**K. Interventions:**

1. NPO after midnight.
2. Site confirmation.

The Joint Commission (TJC) Board of Commissioners initiated the Universal Protocol for Preventing Wrong Site, Wrong Procedure, and Wrong Person Surgery in July 2004. The Universal Protocol was created to avert the occurrence of wrong site, wrong procedure, and wrong person surgery. It was updated January 1, 2009. Principle components of the Universal Protocol are conducting a pre-procedure verification process, marking the procedure site, and performing a "time out" immediately prior to starting the procedure.

**References:**

1. Joint Commission {Internet}. {cited 2008 Nov 15}. Facts about the universal protocol; 2001. Available at: [http://www.jointcommission.org/PatientSafety/UniversalProtocol/up\\_facts.htm](http://www.jointcommission.org/PatientSafety/UniversalProtocol/up_facts.htm)
2. Joint Commission. The universal protocol {Internet}. {cited 2009 May 14}. Available from <http://www.jointcommission.org/PatientSafety/UniversalProtocol/>

## 3. Clipping

Hair removal is commonly performed before many surgical procedures in order to provide the surgeon with a "clean" field and to prevent hair from falling into the surgical site. Most studies have shown an increased risk for Surgical Site Infections (SSIs) in patients undergoing preoperative hair removal. Shaving causes a higher infection rate when compared to clipping the hair or use of depilatory creams. In another study, razors caused gross skin cuts, clippers caused less injury, and depilatory agents caused no injury to the skin surface. Therefore, recommendations are made to use clippers immediately prior to procedure.

**References:**

1. Mangram AJ, Horan TC, Pearson ML, et al. Hospital infection control practices advisory committee. Guideline for prevention of surgical site infection. *Infect Control Hosp Epidemiol* 1999; 20(4):247-278.
2. Mishriki SF, Law DJ, Jeffery PJ. Factors affecting the incidence of postoperative wound infection. *J Hosp Infect* 1990; 16:223-30.
3. Bekar A, Korfali E, Dogan çS, et al. The effect of hair on infection after cranial surgery. *Acta Neurochir (Wien)* 2001;143:533-7.
4. Tanner J, Woodings D, Moncaster K. Preoperative hair removal to reduce surgical site infection. *Cochrane Database Syst Rev* 2006 Apr 19;(2):CD004122.

## 4. Abdominal/Groin Prep

The Centers for Disease Control and Prevention (CDC) makes several recommendations to decrease SSIs,

including one for skin antisepsis. Preoperative antisepsis should be done with an agent with a broad spectrum of activity and a rapid onset with persistent effects. The most commonly used agents are iodophors, alcohols, or chlorhexidine gluconate (CHG). Alcohol is inexpensive, readily available, but has the risk of flammability in a surgical setting. CHG and iodine-based products have a broad spectrum of activity. CHG has greater reductions in skin micro flora and offers residual activity of prolonged and cumulative antibacterial effect when allowed to dry as per directions. CHG is also not inactivated by blood or serum proteins as are the iodine-based antiseptic products. Iodophors exert a bacteriostatic effect as long as they are on the skin. Product recommendation needs to consider patient's ability to comply, due to functional or cognitive status, with showers or baths night before and morning of procedure versus no-rinse impregnated cloths.

**References:**

1. Rhee H, Harris B. Reducing surgical site infections. *Infection Control Today*, March 1, 2008 {Internet}. {cited 2008 Aug 26}. Available at: <http://www.infectioncontroltoday.com/articles/reducing-surgical-infections.html>
2. Hardin WD, Nichols RL. Hand washing and patient skin preparation. In: Malangoni MA, ed. *Critical Issues in Operating Room Management*. Philadelphia: Lippincott-Raven; 1997. p.133-49.

## 5. IV access: large bore (16-18 gauge) peripheral IV

- Through the intravenous infusion line, the surgical team will administer fluids and medication (both anesthetics and analgesic medications)
- Central lines and/or arterial lines frequently are started by anesthesia or surgeon after patient sedation for administration of medications and/or hemodynamic monitoring

**References:**

1. Expert Opinion

## 6. Anesthesia Evaluation

Refers to the series of interviews, physical examinations, and laboratory tests that are generally used to assess the general fitness of patients scheduled for surgery and to determine the need for special precautions or additional testing.

**Purposes of Anesthesia Evaluation:**

- Improve patient safety and quality of care
- Guide the selection of anesthetics and other medications to be used during surgery
- Plan for the patient's postoperative recovery and pain management

**References:**

1. American Society of Anesthesiologists Task Force. Practice Advisory for Preanesthesia Evaluation: A Report by the American Society

of Anesthesiologists Task Force on Preanesthesia Evaluation Practice Advisory for Preanesthesia Evaluation. *Anesthesiology* 2002; 96(2):485-496.

2. Karim A, Esteve M. Specific aspects of the pre-anesthetic consultation in patients with cancer. [in French] *Bulletin du Cancer* 89 2002 June; 612-618.
3. Michota FA, Frost FD. Perioperative management of the hospitalized patient. *Medical Clinics of North America* 86, 2002 July; 731-748.

7. Do Labs: recheck as indicated

- PT/INR
- BUN/Creatinine, GFR
- Fingerstick blood glucose

8. Vitals: blood pressure, pulse, and respiratory rate

9. Assess and mark pedal pulses

**References:**

1. AORN. 2004 Standards, recommended practices, and guidelines. AORN, Inc. 2005 March.

*II Preop Recommendations.*

A. Initial Teaching:

1. Define an aneurysm: as above, brief review with patient to confirm planned surgery.
2. Review treatment options: medical management, surgical or endovascular repair.
3. Discuss preoperative testing.
4. Risk factor modification
  - a. Smoking cessation (refer to page 56, Pulmonary Evaluation).

**References:**

1. Warner DO. 2005.
- b. Hypertension Management-Hypertension is the leading cause of morbidity and mortality worldwide and is a modifiable risk factor for atherosclerosis. Studies have shown that patients with well controlled blood pressures achieve at least a 50% reduction in cardiovascular events.

**References:**

1. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7), Bethesda, MD: US Department of Health and Human Services, National Institutes of Health, May 2003.
2. Kohlman-Trigoboff D. 2004.
- c. Dyslipidemia Management- The use of statin drugs prior to vascular surgery has been shown to decrease the incidence of cardiac complications perioperatively.

guidelines for dyslipidemia. Dyslipidemia can be defined as either elevated levels of total cholesterol, LDL and triglycerides or lower levels of HDL, all of which increase the likelihood of cardiovascular disease. The goal of the NCEP is to refine risk identification and treatment at the individual level, and to encourage widespread screening and education programs to decrease atherosclerotic morbidity and mortality in the population. Optimal lipid levels are: LDL below 100mg/dL, TC < 200 mg/dL, HDL above 40mg/dL for men and above 50 for women and triglycerides below 150 mg/dL. Diet and exercise control are key in the first line treatment of dyslipidemia. However, if drug therapy is also necessary, statins are the most effective LDL lowering agent. If patients are on lipid lowering drugs, they should understand the mechanism of the drug therapy and possible side effects of the drug(s).

**References:**

1. O'Neil-Callahan K, Katsimaglis G, Yeh EN, et al. Statins decrease perioperative cardiac complications in patients undergoing noncardiac vascular surgery: the statins for risk reduction in surgery (StaRRS) study. *J Am Coll Cardiol* 2005;45(3):336-42.
2. Gotto A. Contemporary diagnosis and management of lipid disorders. Newtown, PA: Handbooks in Health Care Co. 2004.
3. Kreisberg RA, Oberman A. Lipids and atherosclerosis: lessons learned from randomized trials of lipid lowering and other relevant studies. *J Clin Endocrinol Metab* 2002; 87(2): 423-437.
- d. Diabetes Management (see **Glucose Control** section above).
- e. Therapeutic Life Style Changes-
  - Diet- should include foods rich in fruits and vegetables and low in fat and sodium
  - Weight reduction (BMI 18.5-24.9 kg/m<sup>2</sup>)
  - Increased physical activity (30 min. aerobic activity approximately 4 days/week)
  - Moderate alcohol consumption (< 2 drinks/day for men, < 1 drink/day for women). One drink is equal to 12 ounce beer, 5 ounces wine, or 1.5 ounces liquor

**References:**

1. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel of Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) *JAMA* 2001 (285): 2486-2497.
2. National Heart Lung and Blood Institute. The seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure (JNC 7), Bethesda, MD: US

The National Cholesterol Education Program (NCEP) and its Adult Treatment Panel (ATP III) have established treatment

Department of Health and Human Services, National Institutes of Health, 2003 May. Available at: <http://www.nhlbi.nih.gov/guidelines/cholesterol/>

#### 5. Benefit of Beta Blockers

Beta blockers are the only agents that reduce the incidence of sudden death and reinfarction in survivors of myocardial infarction in the first 2 years. The beneficial effect was shown to correlate with a reduction in heart rate, the effect being absent or deleterious with beta blockers with marked sympathomimetic activity.

#### B. Preoperative Instructions

1. NPO for surgery.
2. Light diet day before surgery.
3. Benefit of fiber preoperatively to decrease constipation.
4. Skin Prep/Shower.
5. Medications (see Medication Section above).

##### References:

1. Expert Opinion
2. Eastridge D, Rodriguez H, Matsumura J. In: *Vascular Nursing*. 4<sup>th</sup> ed. St. Louis: Saunders; 2004. Chapter 12. Endovascular repair of aortic aneurysms; p. 237-249.

#### III Intraoperative Care.

##### A. BP Parameters are monitored and maintained

1. Patients with severely elevated baseline blood pressure (SBP >180 mmHg) may be at higher risk for hemodynamic instability and cardiac events during endovascular repair.
2. Skin integrity assessed.
3. Neurovascular- compare to baseline.
4. Presence of hematoma.
5. Myocardial ischemia, monitor arrhythmias.
6. Fluid volume/Intake & Output.
7. Surgical sponge and instrument counts.
8. Monitoring of hypoxia.
9. Monitoring for hypothermia- Warming devices should be used perioperatively as normothermia is associated with improved outcomes in surgical patients.
10. Pause and verification (aka "Time Out").

##### References:

1. Insler SR, Sessler DI. Perioperative thermoregulation and temperature monitoring. *Anesthesiol Clin*. 2006 Dec;24(4):823-37
2. Cox C, Borgini L. In: *Vascular Nursing*. 4<sup>th</sup> edition. St. Louis: Saunders; 2004. Chapter 7. Intraoperative nursing care of the vascular patient; p.127-152.
3. AORN. 2005.
4. Joint Commission 2001.

##### B. Diagnostic Studies:

1. Glucose monitoring: Recommend keeping blood glucose concentrations less than 150mg/dl.

##### References:

1. ACC/AHA guidelines. 2002.

#### C. Medications:

1. Heparin
2. Dopamine
3. Nitroprusside
4. Antiemetics
5. Analgesics including narcotic pain medications
6. Neosynephrine

##### References:

1. ACC/AHA guidelines. 2002.

#### D. Interventions:

1. Foley catheter
2. Arterial line and/or automatic BP cuffs
3. Sequential compression devices
4. Warming devices

##### References:

1. Berkes M, Obremsky W, Fletcher N, et al. Prevention of perioperative infections. *J Bone Joint Surg*, Oct 2007; 89:1605-1618.

#### IV. Postoperative recommendations:

##### A. Assessment/Initial orders

1. Surgical floor overnight.
  - Assess airway patency
  - Cardiac monitoring or telemetry if not hard wire monitoring
  - Assess incision(s) for bleeding
  - Assess and compare extremities bilaterally with preoperative evaluation for equality of pulses, temperature, color, and sensation as described in Patient Assessment - Physical Exam
2. Out of bed (OOB) walking post operative day (POD) #1.
3. Sequential compression devices until out of bed and walking and while sitting in a chair.
4. Diet advanced as tolerated.
5. Pain score (0-10) and oral pain medication as needed.
6. Discharge home POD # 1 if vital signs and body functions have resumed normally.

##### References:

1. Eastridge D, Rodriguez H, Matsumura J. 2004.
2. Chang J, Calligaro K, Lombardi J, et al. Factors that predict prolonged length of stay after aortic surgery. *J Vasc Surg* 2003; 38:335-339.
3. Solomon et al. 2000.

##### B. Symptoms of potential complications:

1. Early complications
  - a. Bleeding
  - b. Thrombosis
  - c. Infection
  - d. Renal failure
  - e. Endoleak (typically asymptomatic, but may experience pain if increasing sac size)

- Type I
  - Type II
  - Type III
  - Type IV
- f. Graft migration
- C. Diagnostic Studies:
1. CT Scan for suspected bleeding complications.
  2. Angiogram for endoleak diagnosis and repair.
- D. Medications:
1. Administer medications to control blood pressure/pain.
  2. Resume chronic medications as directed by physician. (see Medications above)
    - Antiplatelet medications
    - Beta Blockers
    - Dyslipidemic medications
    - Antihypertensive/ACE Inhibiting medications
    - Diabetic medications
- E. Interventions
1. Patient Education:
 

Complications

    - Fever >100 degrees Fahrenheit report to surgeon office; many patients have low grade <100 fever for 5-7 days- known as post implantation syndrome
    - Nausea, vomiting: take medications with food; if nausea with vomiting persists, suspect ileus
    - Constipation related to narcotic pain medications: stool softener should be given BID while taking narcotics
    - Scrotal and penis edema: provide scrotal support by elevating with a rolled towel, and ice
  2. Postoperative Medications
    - Oral narcotic analgesics as needed for pain control
    - Stool softener for prevention constipation
    - Antiplatelet/Antithrombosis agents (see above)
    - Dyslipidemic medications: (statins-remove LDL from the circulation; bile acid sequestrants - facilitate the removal of cholesterol through the intestines; niacin - changes the proportions of LDL and HDL produced; cholesterol absorption inhibitors - interfere with the absorption of cholesterol secreted in the bile and enterohepatic circulation; and fibrates - alter the pathways removing triglycerides.

Statins exert a beneficial effect on carotid intimal thickness, atherosclerosis progression in general, and stroke rates. Preoperative statin use is associated with better perioperative and long-term morbidity and mortality in patients undergoing carotid and other noncardiac vascular surgery.

#### References:

1. Kohlman-Trigoboff D. Lipid management in vascular patients, *Journal of Vascular Nursing* 2005; 23(2):72-6.
2. Paraskevas KI, Hamilton G, Mikhailidis DP. Statins: An essential component in the management of carotid artery disease. *J Vasc Surg* 2007; 46: 373-386.

- ACE inhibitors/angiotensin receptor blockers
- Angiotensin-converting enzyme (ACE) inhibitors and Angiotensin receptor blockers (ARBs) reduce mortality, myocardial infarction, stroke, heart failure, need for revascularization, nephropathy, and diabetes and its complications therefore should be started on patients with cardiovascular disease

#### Reference:

1. Teo K, Yusuf F, Sleight P, et al. Rationale, design, and baseline characteristics of 2 large, simple, randomized trials evaluating telmisartan, ramipril, and their combination in high-risk patients: the Ongoing telmisartan alone and in combination with ramipril global endpoint trial/telmisartan randomized assessment study in ACE intolerant subjects with Cardiovascular Disease (ONTARGET/TRANSCEND) trials. *Am Heart J* 2004; 148(1):52-61.
- Diabetic Medications-(see above)
3. Diet: Return to pre-op diet.
4. Incision care:
  - May shower without dressing second day after surgery
  - Avoid tub bathing/swimming for two weeks postoperatively
  - Dry dressing after shower until incisions well-healed
  - Report drainage, bleeding to surgical office
  - Hold pressure, lie down, call for help with any major bleeding

#### Reference:

1. Koninger J, Russ M, Schmidt R, Feilhauer K, Butters M. Postoperative wound healing in wound-water contact. *Zentralbl Chir.* 2000;125(2):157-60.
5. Activity:
  - Up with assistance first day after surgery
  - Return to baseline ambulation on discharge
  - No driving while taking narcotics and until full mobility and strength
  - Sexual- Sexual activity can be resumed when the incision is well- approximated, approximately 1-2 weeks
  - Lifting restrictions as specified by surgeon

#### Reference:

1. Expert Opinion.
6. Diagnostic Testing: Lifetime surveillance
  - a. Clinic visit at 1-2 weeks for wound assessment and at one month post-op with CT scan or abdominal duplex.
  - b. Repeat CT scan or abdominal duplex at 6 months and 1 year, then yearly if no complications.

#### References:

1. Dias NV, Riva L, Ivancev K, et al. Is there a benefit of frequent CT follow-up after EVAR? *Eur J Vasc Endovasc Surg.* 2009 Feb 20.

2. AbuRahma AF, Welch CA, Mullins BB, Dyer B.J. Computed tomography versus color duplex ultrasound for surveillance of abdominal aortic stent-grafts. *Endovasc Ther.* 2005 Oct;12(5):568-73.
3. Elkouri S, Gloviczki P, McKusick MA, et al. Computed tomography and ultrasound in follow-up of patients after endovascular repair of abdominal aortic aneurysm. *Ann Vasc Surg.* 2004; 18(3):271-9.