24 Diagnostic and Therapeutic Strategies for Vascular Injuries (Surgical and Endovascular)

T. Ohki and F.J. Veith

CONTENTS

24.1 Introduction 457
24.2 Principles in the Diagnosis of Major Vascular Injuries 457
24.2.1 Diagnosis 1: Unstable Patients 457
24.2.2 Diagnosis 2: Stable Patients 457
24.3 Principles for the Treatment of Major Vascular Injuries 458
24.4 Endovascular Treatment 459
24.5 Endovascular Stented Grafts 460
24.6 Montefiore Experience with Stented Grafts 461
24.6.1 Technique and Devices 461
24.6.2 Results 461
24.7 Summary 465
References 465

24.1 Introduction

Vascular injuries due to blunt or penetrating trauma can be challenging to diagnose and treat, particularly when they involve central vessels or occur in patients with other major injuries or comorbidities. Over the past 30 years, the optimal management of these vascular lesions has been refined by both military and civilian trauma experiences (Jahnke and Seeley 1953; Perry et al. 1971; Drapanas et al. 1970; Burnett et al. 1976; Feliciano et al. 1984; Rich and Spencer 1978). This chapter describes several general principles which apply to the diagnosis and traditional surgical treatment of major arterial and venous injuries. In addition, it reviews the indications for various endovascular treatment techniques, the literature on the use of endovascular stented grafts for vascular trauma, and our experience with these grafts for traumatic vascular lesions at the Montefiore Medical Center in New York.

24.2 Principles in the Diagnosis of Major Vascular Injuries

24.2.1 Diagnosis 1: Unstable Patients

The diagnosis of penetrating arterial trauma is obvious in patients who present with life-endangering external bleeding. Such patients should be taken directly to the operating room for exploration without delay. Angiography can be done prior to or during exploration in the operating room if necessary and if appropriate equipment is available.

24.2.2 Diagnosis 2: Stable Patients

Preoperative arteriography is indicated in stable patients with a suspected arterial injury on the basis of a pulsatile or expanding mass, ischemia, or decreased pulses distal to the site of injury. Penetrating wounds in proximity to a major artery and in certain specific locations such as the mediastinum or base of the neck also dictate the need for arteriography. Other conditions that mandate diagnostic angiography include violent decelerating injury, dislocation of the knee, and fracture of the first rib. Since most abdominal injuries are accompanied by other organ injury which will usually require operative treatment, arteriography prior to abdominal exploration is rarely indicated.

Spiral contrast computed tomography (CT) or duplex may obviate the need for arteriography. Intravascular ultrasound which may be performed at the time of angiogram will provide certain details such as the exact location and size of the fistula that are otherwise difficult to obtain, especially when coexisting arteriovenous fistula make the angiographic interpretation difficult (Fig. 24.1). These details may be important for performing an endovascular repair.
24.3 Principles for the Treatment of Major Vascular Injuries

It is not necessary to treat all vascular injuries. Occluded minor vessels, including a distal forearm artery or a single tibial artery, can be safely observed. In addition, minor intimal defects, intimal flaps that are adherent downstream, and a pseudoaneurysm less than 5mm in diameter can be managed conservatively, provided the distal circulation is maintained and no active hemorrhage is present (WEAVER et al. 1989). However, care must be taken not to underestimate the degree of arterial injury based solely on angiogram, since pseudoaneurysms filled with thrombus are incompletely visualized on contrast studies.

If operative treatment for internal or external bleeding is indicated, the patient should be volume resuscitated with crystalloid and blood before the operation. Exposure and dissection of the injured area usually results in significant blood loss due to distorted anatomy, and this is poorly tolerated by the patient in a hypovolemic state. In addition, prevention of hypothermia by using a heating blanket and warming intravenous fluids, the anesthetic gases, and the room are important aspects of intraoperative care.

Hemorrhage from venous injury is best controlled by pressure applied around the injured venous structure and then suture repair of the damaged vein. Ligation is reserved for instances of loss of vein substance or injured small extremity veins.

Inflow arterial control is best obtained in a location proximal and distal to and separate from the area of injury. If remote control cannot be obtained rapidly in the face of active hemorrhage, manual compression should be applied to the area of injury. Alternatively, a Fogarty balloon catheter or an occlusion balloon can be inserted through the injury site into the proximal artery and the balloon inflated.

Fig. 24.1. A Pre-interventional angiogram of an iatrogenic arteriovenous fistula (AVF) involving the right common iliac artery due to lumbar disc surgery. The left common iliac vein and the inferior vena cava (i) is visualized by the contrast flowing through the AVF (arrow). However, the exact location of the AVF relative to the internal iliac artery and the precise size of the fistula is not clearly shown. B Intravascular ultrasound (IVUS) image taken at the time of angiography. The amount of substance loss and the location (by identifying the location of the probe of the IVUS under fluoroscopy) is well demonstrated (arrows denote the extent of the fistula). C Coil embolization of the right internal iliac artery. Since the location of the fistula was only 0.5 cm proximal to the origin of the internal iliac artery measured by the technique described above, the internal iliac artery was embolized with multiple coils at the time of angiogram. D Completion angiogram. A Corvita graft (10 mm x 6 cm) was used to repair the AVF. Note the preservation of iliac flow and the obliteration of the AVF.

T. Ohki and F.J. Veith