Clinical Classification of Arterial Grafts

4.1 Introduction

Various arterial grafts have been used for coronary artery bypass grafting. However, except for the internal mammary artery (IMA), which has been regarded as the choice for left anterior descending artery (LAD) grafting, so far there is no unanimous opinion as to the best use of other grafts. Arterial grafts, on the one hand, are all conductance arteries and therefore have features in common compared with venous grafts (see Chap. 3). On the other hand, they are found in different parts of the body and have a different physiological role because the organs they perfuse have a different physiological role. To meet the physiological requirements, these arteries have a different anatomic structure (see Chap. 1) and a different physiological and pharmacological reactivity to vasoactive substances. Furthermore, they are of different embryological origin [1]. Arterial grafts are therefore not uniform in their biological characteristics.

As discussed in Chap. 3, the difference in the perioperative behavior of the grafts and in the long-term patency may be related to different characteristics. These should be taken into account in the use of arterial grafts, some of which require more active pharmacological intervention during and after operation to obtain satisfactory results. To better understand the biological behavior of the grafts, their common features and differences, a clinical classification may be useful for the practicing surgeon.

4.2 Clinical Classification

A large number of studies [2 – 8] have demonstrated different pharmacological reactivities of arterial grafts to vasoactive substances. For example, the gastroepiploic artery (GEA) has the highest contractility to endothelin-1, TxA2, norepinephrine, and K+ [2]. Figure 4.1 shows that of the GEA, IMA, inferior epigastric artery (IEA), and coronary artery, the GEA has the highest contraction force to these four strong vasoconstrictors [3]. Based on experimental studies on the vasoreactivity, taken together with anatomical, physiological, and embryological considerations, we have proposed a functional classification for arterial grafts that may be useful clinically [2] (Fig. 4.2).

Our classification suggests that there are three types of arterial grafts as follows:

Type I: somatic arteries
Type II: splanchnic arteries
Type III: limb arteries

Using anatomical considerations, somatic arteries (Type I) are located in and supply blood to the body wall. The IMA is a typical example of this type of artery. In addition, other somatic arteries such as the IEA, subscapular artery, or intercostal artery belong to this type and their contractility may be similar to that of the IMA, as already demonstrated for the IEA [4] although there are no data available yet for the others. Although the IEA was histologically demonstrated as a muscular artery [9], its pharmacological reactivity is very similar to that of the IMA [2] and their embryological origin is similar. In fact, even from histological study, the wall of the IEA is thinner than that of the GEA [10]. Therefore, it is probably reasonable to classify this artery as Type I, together with the IMA.

Splanchnic (visceral) arteries (Type II) supply blood to the visceral organs. The GEA is a typical example. Other splanchnic arteries such as the splenic artery and the inferior mesenteric artery belong to this type and their reactivity may be similar to the GEA although no data are available as yet. Type III arteries are located in the limb. The radial artery (RA) is a typical example. Other limb arteries such as the ulnar artery and the lateral femoral circumflex artery also fall into this type.

As already mentioned, the Type II artery GEA and the Type III artery RA have a higher pharmacological reactivity to vasoconstrictors. This characteristic may be extended to all Type II and Type III arteries.

Type II arteries are prone to spasm because of the higher contractility of splanchnic arteries. This characteristic of splanchnic arteries has a physiological significance in that blood flow through the splanchnic arteries is subject to tremendous changes under various cir-
circumstances in accordance with the function of the alimentary tract. The flow increases after meals and decreases in critical situations. In contrast, Type I arterial grafts (somatic arteries) are less reactive than Type II grafts because they are mainly “less reactive” conduit arteries except at the end of the artery, which is a muscular regulator for blood flow, as demonstrated in the human IMA [11–13]. As to Type III, these arteries are located in the limbs, represented by the radial artery, and have a higher tendency for spasm compared to somatic arteries (Type I). It is a common clinical observation that arteries at the extremities are usually prone to spasm either at physiological status or under pathological conditions (as seen in Raynaud’s disease).

The prevalence of vasospasm in arterial grafts is also correlated with their endothelial function, as mentioned in Chap. 2. We have recently demonstrated that the Type I artery IMA releases more nitric oxide (NO) and also has higher endothelium-derived relaxing factor (EDHF)-mediated relaxation and hyperpolarization than the Type III artery RA [14]. Other words, a Type I artery, particularly the IMA, may prove to have the best endothelial function among the arterial grafts and this certainly contributes to the superior patency of