Direct Measured Systolic Pressure Gradients across the Aorto-Iliac Segment in Multiple-Level-Obstruction Arteriosclerosis

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Abstract. Patients with severe ischemia due to multilevel obstructions in the leg arteries both above and below the groin were assessed preoperatively by intraarterial brachial and femoral artery pressure measurements. The systolic pressure drop along aortoiliac obstructions was compared to the angiographic findings. A consistent pressure gradient was found in the various types of arterial occlusions.

In patients with occlusion of both the aorta and the iliac arteries, the systolic pressure drop was about 60% (range, 50–78%, SD 9%). The various types of iliac artery occlusions resulted in quite uniform systolic pressure drops of about 50% (range 35–68%, SD 9%). In contrast, the systolic pressure drop along different types of iliac stenoses showed a wide variation, ranging from a minimal drop to about 60%. The degree of stenosis on the angiogram was correlated significantly with the pressure drop. Due to large variations, however, this angiographic information was found to be useless in the individual patient. No difference in the pressure drop was found between cases in which rich and poor collateral networks were visualized.

Key words: Arteries, iliac — Arteries, obstruction — Arteries, pressure measurement — Angiography — Leg, ischemia

With each obstruction in a leg artery, there is a drop in systolic pressure. When the angiogram demonstrates only one obstruction, the cause of the systolic pressure drop (from, e.g., the brachial artery to the ankle) is thereby identified, and a complete normalization of pressure and function can be obtained by surgical removal of this obstruction. Angiography is, however, less informative about the functional significance of multiple-level obstructions. The lesions in such cases may differ in functional importance due to the site, length, and number of occlusions, the degree of stenosis, and the number, site, and length of collaterals.

This study presents the results of direct pressure measurements above and below different types of arterial occlusions and stenoses above the inguinal ligament in patients with multiple-level lesions. This information is useful when an aorto-iliac reconstruction is considered without repair of the occluded femoral segment.

Material and Methods

Seventy-seven legs with chronic occlusive arterial disease were examined in 47 men and 30 women of an average age of 61 years (range, 36 to 74 years). Angiograms with visualization of the pelvic, femoral, and crural arteries demonstrated multiple-level lesions both proximal and distal to the inguinal ligament. In most cases both anteroposterior and oblique exposures were made. The location of the segmental obstructions and the number and the diameters of the collecting part of the collaterals were noted in each angiogram. The degree of arterial stenosis was estimated as a ratio of the smallest diameter of the stenosis as compared to the diameter of the adjacent, nonstenotic area.

Direct blood pressure measurements were performed by a percutaneous approach [3], via polyethylene catheters (o.d., 1.2 mm) inserted in a brachial artery and in the common femoral artery (Elema transducers EMT 34) and were carried out a few days after the angiograms. The pressures in the areas of obstruction above the groin were compared to the systolic pressure index (i.e., the ratio between the systolic pressures of the common femoral and brachial arteries).

Results

Oclusions

From Figure 1 it follows that an occlusion of the aorta and/or one or both segments of the iliac arteries
results in a systolic common femoral pressure index in the range of 0.22–0.65. The mean value for single occlusions was 0.47. The most severe pressure drop was caused by occlusion of the aorta and the common iliac artery, which resulted in at least a 50% reduction in the distal systolic blood pressure. The average pressure index of these aorta-common iliac occlusions was 0.37 ± 0.19. This value is significantly lower ($P < 0.05$) than the mean value found with occlusions of the common plus the external iliac arteries, which was 0.49 ± 0.08. (The systolic pressure index of the common iliac occlusion was 0.54 ± 0.10 and that of the external iliac occlusion was 0.51 ± 0.06.)

There was no correlation between the pressure index and the sum of diameters of the collaterals (Fig. 2). Furthermore, no correlation was found between the length of the occlusion and the pressure index.

**Single Stenoses**

The pressure drop along a localized stenosis of the common or external iliac arteries was 0.72 ± 0.16 and 0.68 ± 0.17, respectively. The degree of stenosis (measured smallest diameter/expected diameter) ranged from 0.13 to 0.75. The range of pressure indices varied widely from 1.00 to 0.40, the latter equal to the pressure drop seen in cases with an iliac occlusion.

In Figure 3 the correlation of the degree of stenosis and the pressure index is shown. A positive correlation was found ($r = 0.42$, $P < 0.05$), but there was a large scatter, indicating that the degree of stenosis seen on the angiogram cannot be interpreted functionally in the individual patient. In only 10 of the 30 legs with iliac stenoses were collaterals shown on the angiograms. The pressure index when collaterals were present was 0.64 ± 0.15, and when there were no visi-