Periacetabular Vascularization in Hip Revision Surgery: A CT Angiographic Study

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INTRODUCTION:

The vascularization of the femoral head in healthy population and in clinical settings is well studied, while there are only a few studies that studied the vascularization of the acetabulum. The "periacetabular ring" was described in the early 2000s in studies performed on cadavers with infection of green-colored latex into the abdominal aorta on cadavers (Figure 1). Since then no more recent studies, or studies with different techniques, were performed. The purpose of the present study is to describe the arterial vascular anatomy of the acetabulum by computerized tomography angiography (CTA) in patients that underwent acetabular component revision at different degrees of acetabular bone defect.

METHODS:

A retrospective analysis looking for patients with aseptic loosening of the acetabular component scheduled for cup revision were performed. We included in the analysis patients with "moderate" (Paprosky IIa, IIb and IIc) or "severe" (Paprosky IIIa, IIIb) acetabular bone defect. We excluded from the study patients with no bone defect (Paprosky I) or patients with severe chronic renal failure or allergic to the contrast agent. CTA images of the pelvis were collected and processed; MPR, MIR, and VRT sequences were analyzed. For each of the above-mentioned arteries, we studied the the presence of their branches. We performed a Chi square test (considering a p-value < 0.05 a statistically significant) to compare the "moderate" and "severe" bone defect population.

RESULTS:

A total of 27 patients were included for the final analysis (16 female and 11 male). The average age at the time of surgery was 78.2 years (64 to 84.5); the mean body mass index was 27.8 Kg/m2 (24 to 31). Eighteen patients had a moderate bone defect (8 Paprosky IIa, 6 Paprosky IIb, 4 Paprosky IIC), while nine patients had a severe bone defect (6 Paprosky IIIA, 3 Paprosky IIB). There were no significant differences for demographic and clinical data between the two groups. The only significant difference was for the number of previous surgeries that was higher for severe bone defect groups (1.6 versus 3.2, $p = 0.0032$) (Table 1).

Superior Gluteal Artery (SGA): we found no significant incidence for the presence of the deep branch in both groups ($p > 0.5$), while for acetabular ramus and supra-acetabular ramus we found a lower presence in the "severe bone defect" group with a p-value respectively of 0.005 and 0.009 (Figure 2).

Inferior Gluteal Artery (IGA): we found significant different incidence between moderate and severe bone defect (respectively 77.8% and 33.3%) for rami of the IGA directed to the posterior wall (Figure 3).

Obturator Artery (OA): for the branches of the obturator artery we found no difference for the presence of anterior and posterior branches between the two groups (respectively p= 0.443 and 0.12), while we found a higher presence of the medial branch in the moderate group (respectively 61.1% and 11.1%, $p = 0.013$) (Figure 4).

Medial Circumflex Femoral Artery (MCFA): in both groups we didn't find the presence of the ramus of the MCFA directed to the postero-inferior acetabular region.

Fourth lumbar artery ($IV^{th}L$) and Iliolumbar artery (ILA): we found no difference between the $IV^{th}L$ and ILA and their branches between the two groups.

DISCUSSION AND CONCLUSION:

Periacetabular bone supply to the acetabulum is less studied compared to the vascularization of the femoral head. The most important finding of the present study is that there is an important reduction in the presence of arterial rami directed to the periacetabular region at moderate and severe acetabular bone defect. In addition, we reported that rami of the SGA, IFA, and the medial branch of the OA showed a significant reduction in cases of severe bone defect. A better knowledge of the periacetabular vascularization could help the surgeon to predict bone growth and implant integration in cup revision surgery.

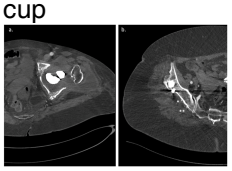

Figure 2: (a) Axial view of the right hip in a Paprosky IIA acetabular bone defect showing the absence of the acetabular and supra-acetabular branches of the SGA. (b) axial view of the left hip in a Paprosky IIa acetabular bone defect showing the presence of acetabular* and supra-acetabular rami of the SGA

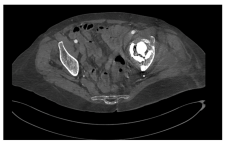

Figure 3: (a) Axial view of the left hip in a Paprosky IIC acetabular bone defect showing the absence of rami of the IGA directed to the posterior wall*

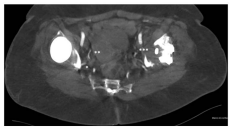

Figure 4: Axial view of the right hip in a Paprosky IIa showing the posterior ramus of the OA*, and the anterior ramus of the OA **. Axial view of the left hip showing the origin the medial branch*** of the OA in a Paprosky IIB bone defect.

Artery	Branches	All patients	"Moderate bone defect"	"Severe bone defect"	p-value*
Superior Gluteal Artery	Deep branch	23/27 (85.2%)	16/18 (88.9%)	7/9 (77.8%)	0.402
	Acetabular branch	25/27 (92.6%)	16/18 (77.8%)	9/9 (100%)	0.005*
	Supra-Acetabular branch	16/27 (59.3%)	13/18 (72.2%)	3/9 (33.3%)	0.009*
Inferior Gluteal Artery	Rami to the posterior wall	17/27 (63%)	14/18 (77.8%)	3/9 (33.3%)	0.013*
Obturator artery	anterior branch	23/27 (85.2%)	15/18 (83.3%)	7/9 (77.8%)	0.443
	Posterior branch	20/27 (74.1%)	15/18 (83.3%)	5/9 (55.6%)	0.12
	Medial branch	21/27 (77.8%)	11/18 (61.1%)	1/9 (11.1%)	0.013*
Medial Circumflex Femoral Artery	Rami to the posterior inferior acetabulum	0/27 (0%)	0/18 (0%)	0/9 (0%)	NA
Fourth Lumbar Artery	Acetabular branch	21/27 (92.9%)	17/18 (94.5%)	8/9 (88.9%)	0.603
	Inferior ramus	21/27 (81.5%)	15/18 (83.3%)	7/9 (77.8%)	0.435
Iliolumbar Artery	Superficial ramus	17/27 (63%)	16/18 (89%)	3/9 (100%)	NA
	Deep ramus	17/27 (63%)	16/18 (89%)	3/9 (100%)	NA
	Superior ramus	23/27 (88.9%)	16/18 (88.9%)	8/9 (88.9%)	0.999
	Inferior ramus	20/27 (74.1%)	14/18 (77.8%)	6/9 (66.6%)	0.534
	Nutrient artery	25/27 (92.6%)	17/18 (94.5%)	8/9 (88.9%)	0.603

Table 1: Arteries and branches that provide blood supply to the periacetabular region in "moderate" and "severe" bone defect. * statistically significant difference (p< 0.05). We found a significant difference for the presence of acetabular and supra-acetabular branches of the SGA, for the rami to the posterior wall of the IGA, and for medial branch of the OA. We found no significant differences for the other arteries.

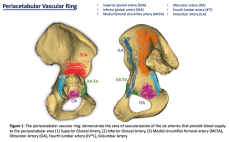

Figure 1: The periacetabular vascular ring demonstrate the area of vascular bottom of the sin anterior that provide blood supply to the periacetabular area (1) Superior Gluteal Artery, (2) Inferior Gluteal Artery, (3) Medial circumflex femoral artery (MCFA), Obturator Artery (OA), Fourth lumbar artery (4°TL), Iliolumbar Artery