Reduced bleeding through temporary balloon occlusion in hip and knee revision surgery

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ABSTRACT — We used temporary balloon occlusion of the iliac or femoral artery to reduce blood loss in major hip or knee operations in 15 cases in 13 patients. The balloon was introduced by an interventional radiologist in the afternoon of the day before surgery or in the morning before. A latex occlusion balloon was inserted via the transfemoral ipsi- or contralateral route. The patients received two 40 mg doses of low molecular weight heparin. At the beginning of the operation, saline was injected into the predetermined volume to inflate the balloon. The balloons were inflated during 1–6 hours. In each case, the balloon occlusion clearly reduced bleeding in the surgical field and facilitated surgery. The perioperative bleeding was reduced by half, as compared to a retrospective control group. We measured the intraarterial blood pressures distally to the balloon in 2 patients. They decreased from 120 to 40 mm Hg and 155 to 50 mm Hg, respectively, after inflation. Two complications occurred, one bleeding due to catheter dislocation the night before surgery and one postoperative necrosis of the tip of a toe in a patient in whom the deflated balloon was not extruded until the day after surgery and the dose of heparin was too low.

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Temporary arterial balloon occlusion has been reported to control intraabdominal bleeding in cases of severe penetrating abdominal trauma (Hughes 1954, Hesse and Kletschka 1962, Gupta et al. 1989). Temporary balloon occlusion has been reported for the basilar artery (Bailes et al. 1992). The method was reported to prevent bleeding in a case with rupture of an abdominal aortic aneurysm (Hesse and Kletschka 1962). In the lower extremity, balloon occlusion femoral angiography has been used to evaluate the patency of the plantar arch prior to saphenous by-pass surgery (Cardella et al. 1987). We report our experiences on the use of the balloon occlusion technique in hip and knee surgery in 13 patients.

Patients

We used temporary balloon occlusion of the iliac or femoral artery in 15 cases in 13 patients (7 men) aged 42–88 years (Table). 7 of the surgical procedures were revision hip arthroplasties of which 5 included impaction grafting. 3 procedures were revision knee arthroplasties including impaction grafting (Ullmark and Hovelius 1996). 1 case was a fusion of the knee and 4 were primary hip arthroplasties. All patients had epidural anesthesia with bupivacaine hydrochloride.

Technique

Balloon introduction was done by an interventional radiologist in the radiological department in the afternoon of the preoperative day (10 cases) or in the morning before surgery. An 11.5 or 20 mm latex occlusion balloon (Medi-Tech, Boston Sci) was inserted through a 7 or 8 French straight or bent introducer (Balkin up and over COOK) via the transfemoral ipsi- or contralateral route. Pelvic angiography was performed to visualize the arterial circulation before the balloon was placed at the bifurcation of the common iliac femoral artery. The position of the balloon was stabilised by the introducer. The occlusive result and collateral circulation were checked by femoral angiography

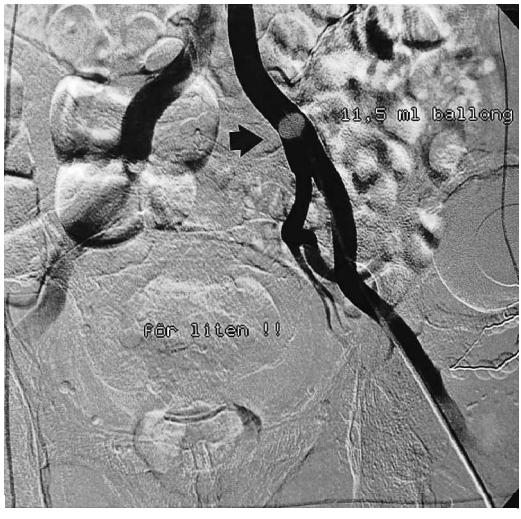
Clinical data of 13 patients in 15 cases using temporary balloon occlusion

Case	Sex	Age	Diagnosis [a]	Surgery [b]	Balloon size, mm	Balloon location [c]	Operation time, min	Occlusion time, min	Bleeding L	Transfusion L	Complication
1	F	61	R M	RK g	11.5	F	415	120	6.0	4.2	None
2	F	62	O I	KA	11.5	F	135	135	1.0	0.6	None
3	M	54	O I	RH g	11.5	C	160	190	1.8	2.1	None
4	M	74	O M	RK g	11.5	F	315	315	1.6	1.8	Foot cold
5	M	67	O I	RH g	20	C	330	320	1.5	2.1	None
6	M	42	O I	RH g	11.5	C	150	150	2.2	1.6	None
7	M	66	O I	RH g	20	C	370	360	3.5	2.8	None
8	M	67	O M	RK g	20	F	275	275	0.6	0.34	None
9	F	88	O M	RH f	11.5	C	170	0	3.6	5.4	None
10	M [d]	75 [d]	O P	TH	20	C	70	65	2.0 [d]	1.4 [d]	None
11			O M	RH g	20	C	140	145			None
12	F	54	O P	TH	20	C	100	75	0.4	0.42	Bleeding
13	F	58	R I	RH	20	C	405	240 + 60	1.0	1.2	Ulcer
14	F [d]	75 [d]	O P	TH	20	C	75	75	0.2	0.13 [d]	None
15			O P	TH	20	C	75	75	0.2		None

[a] R rheumatoid arthritis, O osteoarthrosis,
I periprosthetic infection, M mechanical loosening of arthroplasty, P primary.
[b] KA knee arthrodesis, RH revision total hip arthroplasty, RK revision total knee arthroplasty, TH total hip arthroplasty
f femur fracture, g graft impaction.
[c] F femoral artery, , C common iliac artery.
[d] bilateral hips.

with an inflated balloon (Figure) and in 2 cases by measuring intraarterial blood pressure distal to the balloon as well (Datex AS/3 using Gabarith DT-XX disposable transducer from Ohmeda). When properly placed, the balloon catheter/introducer system were fixed (taped) to each other and to the skin. The catheter and introducer were marked to show any movement between them and the skin.

Adequate balloon filling was defined, the volume documented and reported to the surgeon. The balloon was left deflated and the patient given 40 mg of low molecular weight heparin, morning and



(a) Angiography shows adequate circulation in the iliac vessels and a 11.5 mm balloon in good position in the common iliac artery which, however, was too small with insufficient occlusion (arrow).

(b) Angiography shows a 20 mm balloon with complete obstruction of the left common iliac artery (arrow) and flow in the right internal and external vessels.

evening on the day of surgery starting the evening of the day before surgery to avoid catheter-induced thrombosis. This procedure takes approximately 10 minutes for an experienced interventionalist. In the operating theater, saline was injected into the predetermined volume to inflate the balloon after checking that the balloon position was stable at the time surgery was started.

Results

There were 3 complications. In 1 patient, the balloon catheter dislocated during the night before surgery resulting in bleeding. Another patient developed postoperative necrosis affecting the distal 4 mm on the tip of the third toe. Two of our routines were not followed in this case. The balloon was deflated at the end of surgery, but since surgery stopped late in the evening, the catheter was extruded first the next day. The prophylaxis dose against thrombosis was given once instead of twice that day. A third patient had slight transient coldness of his foot during the night after surgery. One small balloon ruptured shortly after inflation, causing no harm to the patient.

The intraarterial pressure distal to the balloon in the common iliac artery was measured in 2 patients (cases 6 and 7). The pressure fell from 120 to 40 mm Hg and from 155 to 50 mm Hg, respectively, after inflation. The time for surgery was not prolonged by handling the balloon catheter. No metabolic or hemodynamic changes were observed after deflation except for the complication described above, nor did any circulatory problems developed in the operated leg later. 3 of the cases (3, 5 and 7) were compared to a matched retrospective group of 12 patients operated on with a second stage of a 2-stage revision procedure for infected hip prostheses. The average perioperative bleeding was 0.5 L per hour for the balloon group, compared to 1 L for the matched group.

Discussion

We found temporary occlusion of the main arteries in the lower extremity facilitates surgery. The complication of bleeding due to catheter dislocation could probably have been avoided by introducing the catheter in the morning before surgery followed by adequate supervision of the patient. The complication of a necrotic ulcer of a toe was probably caused by a microembolism distal to the catheter due to prolonged catheterization, and the thrombosis prophylaxis was not adequate. The 11.5 mm balloon ruptured in one case. This incident did no harm to the patient except the surgical bleeding was not reduced. We now use a 20 mm balloon in the common iliac artery. In 10 of our cases, we introduced the balloon about 18 hours before surgery. However, since the risk of catheter-induced thrombosis most probably increases with time, we now recommend that the balloon be introduced just before surgery. This will also reduce the risk of displacement of the introducer and/or balloon during the night before surgery. We recommend that before temporary occlusion is included for a longer time, the collateral circulation, arterial conditions in the whole leg as well as the amplitude of the pulse of the femoral artery should be assessed. This is especially important when the balloon occlusion technique is used in knee surgery. Preoperative measuring of blood pressure index arm/ankle should be performed in cases of doubt. We do not know if an inflated balloon can damage the intima of the vessel if occlusion is continued for longer than 5–6 hours. Postoperative bleeding did not occur. Initially, we introduced the balloon system through the contralateral side but we now prefer the ipsilateral femoral artery. The fall in intraarterial blood pressure measured in 2 patients (to 40 and 50 mm Hg, respectively) indicates that the extremity is well perfused through collaterals. Thus the balloon occlusion should be better tolerated than a tourniquet (Estebe and Malledant 1996). Our impression is furthermore that bleeding blood vessels are more easily identified for hemostasis during surgery.

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