Embolization of spinal metastases reduces peroperative blood loss

21 patients operated on for renal cell carcinoma

Claes Olerud[1], Halldór Jónsson Jr[1], Ann-Marie Löfberg[2], Lars-Erik Lörelius[2] and Lennart Sjöström[1]

We evaluated the peroperative blood loss in 21 patients who were treated with 29 operative procedures for thoracolumbar spinal renal cell carcinoma metastases. Embolization was undertaken prior to 11 operations. At posterior surgery the average blood loss was one third after embolization compared with when embolization had not been performed. The blood loss was also lower during anterior surgery, although this difference was smaller. We recommend that preoperative embolization should precede surgical treatment of spinal metastases of renal cell carcinoma where it can be anticipated that the operation will extend into the pathological tissue.

Departments of [1]Orthopedics and [2]Diagnostic Radiology, Uppsala University Hospital, S-751 85 Uppsala, Sweden
Tel +46-18-66 30 00. Fax -18-50 94 27
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We report the effect of preoperative embolization on blood loss in operation on renal cell carcinoma metastases of the spine.

Patients and methods

The series consisted of 21 consecutive patients, 10 women and 11 men with a mean age of 63 (47–78) years, with spinal metastases of renal cell carcinoma treated at the our hospital between 1981 and 1991 (Table 1). 10 of the metastases were in the thoracic and 11 were in the lumbar spine. The indication for the operation was in each case severe local pain and/or impending neurological injury. No patient had a severe neurological injury before the operation.

The operation

The operation varied as the technique evolved and depended on the location of the metastasis within the vertebra. A total of 29 operations were performed, 20 posterior and 9 anterior. Resection through metastatic tissue was necessary in each case. The posterior procedures consisted of decompression of the dural sac and affected nerve roots with fixation of the spine from the back. From 1981 to 1985 the posterior fixation was done with Harrington rods. From 1986 a transpedicular fixation device (Posterior Segmental Fixator, PSF, Hosptech, Sweden) has been used. The anterior procedures consisted of decompression and fixation through the thorax or abdomen. Embolization was regularly used from 1988 and was performed prior to 5 posterior and 6 anterior procedures. The operation was regularly performed less than 24 hours after the embolization.

Preoperative embolization

Angiography of the involved segmental arteries, as well as of the segmental arteries above and below, was performed bilaterally using digital subtraction. A 1.3-mm braided catheter with cobra or shepherd's hook-shaped curve (Cordis, U.S.A.) was used. Omnipaque™ 180 mgI/mL (Nycomed, Norway) was used as the contrast agent. The angiographies were thoroughly scrutinized for existing major spinal cord branches, especially the Adamkiewicz artery (Adamkiewicz 1882, Choi and Bernstein 1988). After any main contribution to the anterior spinal artery had been ruled out, the major feeding artery to the tumor was recatheterized. The catheter was positioned as close to the tumor as possible, using either a 0.96-mm low-friction guide wire (Terumo Co., Japan) or a super torque 0.64-mm guide wire (Schneider, Switzerland). Particles of gelatin sponge (Spongostan™, Ferrosal, Denmark) or polyvinyl alcohol (Wet Filtered Ivalon™, Nycomed Ingenor, France) mixed with the contrast agent was used as embolization material. To prevent back-flow of the embolization, the procedure was closely followed with fluoroscopy. Repeated control angiographies were also performed during the emboli-

Table 1. Observations in 21 patients operated on for renal cell carcinoma metastases of the spine

A	B	C	D	E	F	G	H	I	J	K	L
1	1	F	63	Th12	0		1	1	1	5.7	0
2	2	M	78	L1	0		1	1	1	2.7	1
3				L1	0		1	1		3.3	0
4	3	F	61	L4	0		1	1	1	3.9	0
5	4	M	64	L4	0		0	1	1	2.4	0
6	5	M	47	L1	0		1	1	1	6.8	0
7	6	F	58	Th10	0		1	1	1	4.7	0
8	7	M	52	Th6	0		1	1	2	4.5	0
9	8	F	67	Th4	0		1	1	1	12.1	1
10	9	M	77	Th12	0		1	2	1[a]	2.7	0
11				L5	0		1	2	3	14.5	2
12	10	F	70	L1	0		1	1	4	3.7	0
13	11	F	66	Th9	0		1	1	4	19.0	0
14				Th9	0		1	2		7.5	0
15	12	F	54	Th11	0		1	1	4	5.0	0
16				Th11	1	Th10 dx, Th11 sin	0	2		3.6	0
17	13	F	58	L2	0		1	1	4	7.3	0
18				L2	1	L2 sin, L3 sin	1	2		9.0	0
19	14	M	66	Th12	1	L1 sin, L2 sin, L2 dx, int iliac art. sin	0	1	4	2.2	0
20	15	M	59	Th11	0		1	1	4	12.8	0
21				Th11	1	Th11 sin,Th12 sin,Th12 dx	0	2		8.0	0
22	16	F	76	Th12	1	Th12 dx	0	1	4	1.5	0
23				Th12	1	Th12 dx	0	2		3.7	0
24	17	F	75	L2	1	L2 sin	0	1	4	6.0	0
25	18	M	60	L5	1	L5 dx, med sacral artery	0	2	4[a]	1.8	0
26	19	M	60	Th11, Th12, L1	1	Th11 sin, Th11 dx, Th 12 dx	0	1	4	6.0	3
27	20	M	49	L3	1	L2 sin, L3 sin, L3 dx	0	1	4	0.6	0
28	21	M	55	L4	0		1	1	4	2.3	0
29				L4	1	L4 sin, L4 dx	0	2		4.7	0

A Operation no.
B Case
C Sex
D Age
E Level
F Embolization
  0 no
  1 yes
G Embolized arteries
H Surgeon's impression
  0 bleeding no problem
  1 bleeding difficult
I Procedure
  1 Posterior
  2 Anterior
J Fixation
  1 Harrington rod
  2 plates
  3 PMMA cement
  4 transpedicular device
K Bleeding in liters
[a] Patient initially stabilized with posterior surgery; no tumor growth in the posterior structures
L Outcome of embolization and surgery
  0 Uneventful
  1 Postoperative paraplegia
  2 Patient died 4 days postoperatively
  3 Patient experienced pain from the embolization

zation procedure to check if collateral pathways had opened up to the anterior spinal artery, a complication that never occurred in the present series. After successful embolization of the main feeding artery, any existing contributory arteries were also embolized. A total of 23 arteries were embolized in 10 patients (11 embolization procedures).

Registration of blood loss

The peroperative blood loss was calculated by the anesthesiologist by adding the blood volume collected in the wound swabs, suction bottles, and an estimate of the volume in the operating field. As the aim was to study the amount of blood lost during the surgical procedure, no account was made of postoperative blood loss from the wound, or in drain bottles. The surgeon's impression of the bleeding, notably whether this was a problem during the operation, was also evaluated.

Statistics

Because posterior and anterior procedures differ so much in terms of exposure and anticipated blood loss, the effect of embolization in these two subgroups were analyzed separately. The mean blood loss and its standard deviation was established. The 95 percent confidence interval was also calculated. The difference between the groups was tested with Kruskal-Wallis nonparametric analysis of variance.

Table 2. Perioperative blood loss (L) in the different subgroups; mean *SD* (95 percent confidence interval)

	Procedure	
Embolization	Posterior	Anterior
No	6.4 *4.7* (4.1–8.7)	8.2 *5.9* (2.8–14)
Yes	2.2 *2.2* (0–6.2)	5.1 *2.8* (1.3–8.9)
P	0.02	0.6

Results

No neurologic or other complications occurred among the embolized patients. Case 19 with an extensive soft tissue expansion of the metastasis experienced local pain for some hours after the embolization, whereas the others tolerated the procedure well. Cases 2 and 8 who were not embolized became permanently paraplegic within 24 hours after the operation, most probably due to epidural hematomas that developed postoperatively.

The perioperative mortality among the embolized patients was nil; 1 patient from the non-embolized group died 4 days after an anterior vertebrectomy because of uncontrollable bleeding with 15 L peroperatively (Case 9).

The blood loss was between 0.6 and 19 L, with an average of 5.6 *4.4* L (mean *SD*). It was 5.4 *4.6* L after posterior surgery and 6.2 *4.0* L after anterior surgery. The embolization reduced the blood loss in posterior surgery to a third (*P* 0.02; Table 2). The blood loss in anterior surgery was also lowered by embolization, but the difference was not significant. This may be explained by the small number of cases in this subgroup and the fact that blood loss in anterior surgery is generally high. The amount due to bleeding from the tumor tissue itself is then of less importance.

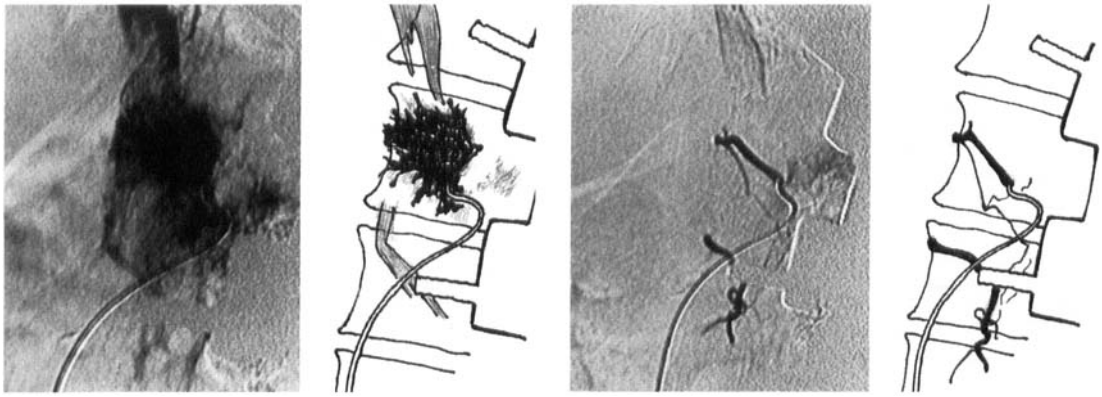
The surgeon's impression was that in the embolized patients, bleeding from the tumor tissue was negligible. It was therefore possible to perform the operation without the interference of continual bleeding. When embolization had not been performed, however, bleeding increased the technical difficulty of the surgery.

Discussion

In metastatic disease of the spine, the surgical intervention aims towards decompression, either by direct removal of metastatic tissue (Kostuik 1983, Siegal et al. 1985, Onimus et al. 1986, Harrington 1988, Moore and Uttley 1989) or indirectly by means of ligamentotaxis by reduction of the collapsed vertebra (Olerud et al. 1992). Usually these operations can be performed without any major bleeding problem. Harrington (1988) reported the blood loss to vary between 0.05 and 4.3 L in a series of 77 metastases treated with mainly anterior surgery and Onimus et al. (1986) reported the average blood loss in a series of 60 vertebral metastases to be 1.5 (0.2–4.8) L.

In renal cell carcinoma, however, the tumor tissue is very well vascularized and there is a risk of massive blood loss. Probablybecause of the risk of uncontrolled bleeding, the experience with surgical management of spinal metastases from renal cell carcinoma is limited. Galasko (1988) reported only 1 case of renal cell carcinoma in a series of 43 patients, Harrington (1988)

Figure 1. Case 13



Preembolization subtraction angiogram of the second lumbar artery feeding a renal cell carcinoma metastasis in the L2 vertebral body.

After selective embolization, most of the tumor vessels have been obliterated.

reported 6 cases in his series of 77 patients, and Onimus et al. (1986) reported 3 cases in their series of 60 patients, whereas one fifth of all surgically-managed spinal metastases in our unit are of renal cell origin.

Preoperative embolization has been recommended for renal cell carcinoma metastases (Rowe et al. 1984, Waneck et al. 1989, Gellad et al. 1990). In our series this seems to have contributed to the reduction of bleeding. We did not see any ischemic neurological injury; a complication which should be avoidable by meticulous angiographic technique.

A special consideration concerns timing of surgery in patients with neurologic deterioration and impending paraplegia. In other tumor conditions one would consider emergent surgical intervention. In renal cell carcinoma, however, delaying the operation a few hours in order to perform the embolization is probably beneficial. Our series clearly illustrates that the acute intervention without embolization carries a substantial risk of neurological damage. In cases of anterior pressure on the dural sac due to acute kyphosis through vertebral body collapse without tumor growth in the vertebral arch, however, we have previously shown that anterior decompression can be achieved by reduction of the kyphosis from the back (Olerud et al. 1992). If this can be carried out without coming in contact with the pathological tissue, preoperative embolization will not be necessary. Second stage anterior surgery, if needed, can then be postponed until after embolization has been performed.

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