

Low risk of cardiac events during intramedullary instrumentation of lung cancer metastases

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Background Instrumentation, particularly reaming, of the long bones carries the risk of embolic phenomenon. Emboli may result in pulmonary injury, which is usually manifested by desaturation. This pulmonary injury may be particularly relevant if there is diminished pulmonary reserve due to pre-existing lung disease such as lung carcinoma. In extreme cases, this can result in cardiac arrest intraoperatively.

Patients and methods We reviewed 34 consecutive operations that involved instrumentation of long bones for metastases of lung carcinoma.

Results Desaturation developed during 1 procedure, and there was hypotension in 5 patients. In addition, cardiac arrest occurred intraoperatively in 1 patient, which was the only fatality.

Interpretation This study has shown that while emboli during femoral instrumentation may be common, significant clinical manifestations of this phenomenon are uncommon.

Lung carcinoma is one of the most common cancers requiring orthopedic stabilization for long bone metastases. Previous studies have confirmed that intramedullary fixation is associated with embolic particles (Assal et al. 2000, Handolin et al. 2004) and instrumentation of a femoral metastasis may be associated with cardiorespiratory and vascular dysfunction (CRVD) (Choong 2003). While this risk exists for all patients undergoing long bone instrumentation, it may be more likely in the presence of underlying respiratory disease—as is found with primary lung carcinoma. Barwood

et al. (2000) reported an incidence of CRVD in one quarter of all patients who underwent femoral nailing for a metastasis from one of a number of different primary cancers, the most common being breast cancer. The authors did not state whether the metastatic disease affected the lungs, a situation that would possibly make them more at risk of having CRVD.

Patients with primary lung cancer and a femoral metastasis carry a very high risk of developing CRVD, as their pulmonary reserve must be reduced by the primary disease. The decision to intervene surgically and stabilize an impending or existing fracture thus presents a real risk of intraoperative complication, including death. The risk of serious intraoperative events in this situation has not been reported.

We reviewed the incidence of desaturation and/or hypotension, including significant cardiac events, in patients who are most at risk of such events: those undergoing osteosynthesis of lung cancer metastases in long bones.

Patients and methods

All patients who presented to the South Australian Musculo-Skeletal Tumour Unit with a pathologically confirmed metastasis from lung carcinoma that required intramedullary fixation during the period 1993–2006 were included in the study. The patients' notes were retrospectively reviewed to record general patient demographics of age, sex, site, and procedure, in addition to specific data on episodes of

Patient demographics

Age (years)	Sex	Preoperative fracture (Y/N)	ASA	Operation	Adjuvant	Intraoperative event
71	M	Y	3	BHR	Cement	Cardiac arrest
74	M	N	3	BHR	Cement	
79	F	Y	3	BHR	Cement	
53	M	N	3	IM nail	Cement	
54	F	Y	3	IM nail	Nil	
54	M	N	3	IM nail	Cement	Drop in BP
56	M	N	3	IM nail	Nil	
59	F	N	3	IM nail	Nil	
62	F	N	3	IM nail	Nil	
64	M	Y	2	IM nail	Nil	
65	F	N	3	IM nail	Nil	
66	M	N	3	IM nail	Nil	
67	F	N	3	IM nail	Nil	
67	F	Y	3	IM nail	Nil	
68	M	N	3	IM nail	Nil	
69	M	N	3	IM nail	Cement	Saturation drop
71	M	N	3	IM nail	Nil	
72	M	Y	4	IM nail	Nil	
73	M	N	3	IM nail	Nil	
73	M	Y	3	IM nail	Nil	
73	M	N	3	IM nail	Nil	Drop in BP
51	M	N	3	THR	Cement	
52	F	N	3	THR	Cement	
62	F	N	3	THR	Cement	
63	F	Y	3	THR	Cement	
73	F	N	3	THR	Cement	Drop in BP
83	F	N	3	THR	Cement	
55	F	N	3	THR & cage	Cement	
64	F	N	3	THR & TM	Cement	
46	F	Y	4	UHR	Cement	
47	F	N	3	UHR	Cement	
48	F	N	3	UHR	Cement	
48	M	N	3	UHR	Cement	
65	M	N	3	UHR	Cement	

BHR: bipolar hip replacement; IM nail: intramedullary nail; THR: total hip replacement; UHR: unipolar hip replacement; TM: trabecular metal.

desaturation, hypotension, or cardiac event.

32 patients (mean age 63 (46–83) years, 17 males) who underwent 34 procedures were included. Bilateral procedures were performed in 2 female patients metachronously (Table). All patients were assessed by an anesthetist and scored according to the American Society of Anesthesiologists (ASA) rating. 1 patient was rated as risk level 2, 31 were rated as risk level 3, and 2 were rated as risk level 4 (Table). In total, the metastases were treated using 18 intramedullary femoral nails and 16 femoral stems (as part of a partial or total joint replacement procedure). Large lytic areas were curetted before reaming. Reaming was undertaken in all patients prior to

nail or stem insertion. Pulsatile lavage was used to remove loose debris within the femoral canal before injection of cement. Cement was used in all femoral stems and as an adjuvant in 3 femoral nails.

Femoral stems were used either in combination with an acetabular component (with or without cage augmentation), a bipolar head, or a unipolar head. Cement was introduced with a cement gun, but a distal cement restrictor was not used and no attempt was made to pressurize the cement. The stem was inserted before the cement had become “doughy”, to ensure its complete passage down the shaft.

The criteria used to record a significant pulmonary event were a decrease in oxygen saturation of

at least 3% or a drop in systolic blood pressure of ≥ 30 mm Hg (Barwood et al. 2000). Intraoperative monitoring was undertaken using pulse oximetry, and in most cases continuous arterial line blood pressure monitoring via the radial artery. Patients were monitored until discharge and complications noted.

Results

There were significant intraoperative events in 5 cases. Cardiac arrest occurred in 1 patient as a femoral stem was inserted into the cement mantle. The patient was resuscitated, but died within 12 h. A transient drop in blood pressure without desaturation was observed in 2 patients undergoing a cemented femoral stem replacement. The drop in blood pressure coincided with injection of cement. A significant drop in blood pressure was also observed in 1 patient undergoing intramedullary nail insertion; cement was not associated with this event. The hypotensive episode was managed by fluid bolus treatment and resolved without incident in all cases except the 1 patient who progressed to cardiac arrest. A drop in oxygen saturation was observed in 1 patient, also in association with injection of cement. There were no additional complications in the perioperative period.

Discussion

It has long been held that intramedullary nailing, such as for a diaphyseal long bone fracture, carries a risk of pulmonary complications—especially in association with concomitant chest injuries (Bone et al. 1989, Behrman et al. 1990, Pape et al. 1993, Assal et al. 2000). This has been reported to be secondary to fat embolism produced either by reaming or nail insertion (Cohn and Zieg 1996) in cases with diminished pulmonary reserve (Norris et al. 2001).

Intramedullary nail fixation or long femoral stems are effective methods of treating metastases involving long bones. One reported complication of this procedure is pulmonary embolism manifested by hypotension, arrhythmia, and oxygen desaturation (Kerr et al. 1993, Choong 2003). In

addition to the risk from fat emboli, air, tumor, bone marrow-thrombus aggregates, or other vasoactive inflammatory substances have also been implicated (Modig et al. 1975, Christie et al. 1995, Karachalios et al. 2002). Barwood et al. (2000) reported desaturation and hypotension in 11 of 45 patients treated by intramedullary nailing for fractures or impending fractures of the femur. 3 patients died as a result of the intraoperative event. It was believed that the emboli released were secondary to reaming of the canal, but a number of reports have been published describing the same complication despite the use of unreamed nails (Bone et al. 1989, Peter et al. 1997, Buttaro et al. 2002). The use of methylmethacrylate has also been reported to induce hypotension (Patterson et al. 1991, Herrenbruck et al. 2002). Karlsson et al. (1995) demonstrated that methylmethacrylate monomer could produce hypotension by acting directly on vascular smooth muscle. In our series, cement was used in 19 patients and significant CRVD developed in 4. This contrasts with the results of Herrenbruck et al. (2002) where CRVD developed in 34 of 55 patients undergoing cemented long-stem arthroplasty. The latter study did not report on the method of canal preparation prior to injection of cement and stem insertion. We believe that curettage of tumor prior to reaming and the use of pulsatile lavage also reduces the risk of embolization.

This study has reviewed a group of patients that would be expected to be at higher than usual risk of cardiorespiratory and vascular dysfunction. This is the largest reported series of patients with lung cancer treated by intramedullary fixation/replacement. Despite their concomitant pulmonary disease, significant clinical manifestations of CRVD were relatively uncommon (5/32). All patients except 1 responded to simple fluid load and did not require vasopressor support. The perioperative mortality rate was 1/32. This is useful information, which can be provided to patients and their relatives to inform them of the risk and to assist in obtaining informed consent.

Contributions of the authors

MC: designed the study, collated the results, and wrote the article. XT: performed the literature search and contributed to the writing of the article.

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