Simultaneous Nailing of Skeletal Metastases

Is the Mortality Really that High?

Bryan Moon MD, Patrick Lin MD,
Robert Satcher MD, PhD, Valerae Lewis MD

Received: 22 July 2010 / Accepted: 4 February 2011 / Published online: 17 February 2011
© The Association of Bone and Joint Surgeons® 2011

Abstract

Introduction The risk of death during simultaneous nailing of pathologic and impending fractures in patients with metastatic disease is believed to be so high that some authors have advocated a staged approach, especially for impending fractures. However, there are limited data to either support or refute the appropriateness of staging of multiple impending or pathologic fractures.

Questions/purposes We therefore determined the rate of pulmonary mortality and morbidity in patients who underwent simultaneous nailing for metastatic disease of the skeleton.

Methods We retrospectively reviewed 16 patients who underwent simultaneous intramedullary nailing of impending or pathologic fractures between 1993 and 2009. There were 10 men and six women with a mean age of 60 years (range, 40–78 years). The intramedullary nailings included 15 femurs, 17 humeri, and one tibia. Thirty-one nails were reamed and two were unreamed.

Results Three of 16 patients died before discharge; two of these deaths were presumed to be the direct result of acute pulmonary complications related to simultaneous nailing

and one was intraoperative. For the 13 patients who survived after discharge, there were three pulmonary complications. There were no intraoperative or perioperative deaths in the prophylactic nailing group.

Conclusions Simultaneous nailing of impending and pathologic fractures can be performed with lower mortality rates than previously reported. Patients with impending fractures did not appear to be at higher risk than patients with pathologic fractures.

Level of Evidence Level IV, therapeutic study. See the Guidelines for Authors for a complete description of level of evidence.

Introduction

Intramedullary nailing of long bones has become an accepted form of treatment for impending and pathologic fractures. Although this form of treatment is commonplace, concerns still arise regarding the risks of pulmonary compromise and mortality owing to fat and tumor emboli that are generated during nailing. The concern for these risks is substantial and has resulted in discussion of techniques, such as venting and unreamed nailing, that potentially might reduce production of emboli [6, 9, 10].

The patient with multiple impending or pathologic long bone fractures presents a greater challenge. As these patients are subject to a higher volume of fat and tumor emboli, the risk of pulmonary compromise and mortality theoretically would be correspondingly greater. The risk is believed to be so great that some authors advocate avoiding simultaneous nailing and recommend a staged approach especially for impending fractures [3, 7–10].

Although these recommendations intuitively seem sound, we found no data supporting the staging of stabilizing

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

B. Moon (✉), P. Lin, R. Satcher, V. Lewis
Department of Orthopaedic Oncology, MD Anderson Cancer
Center, PO Box 301402, Houston, TX 77230-1402, USA
e-mail: bsmoon@mdanderson.org

multiple impending or pathologic fractures. Additionally, other variables, including chemotherapy windows, available operating room time, medical condition of patients, and cost, may make staged procedures less practical.

We therefore evaluated the (1) rate of pulmonary mortality and (2) pulmonary morbidity in patients who undergo simultaneous nailings.

Patients and Methods

We retrospectively reviewed the medical charts of 17 patients who underwent simultaneous intramedullary nailing of impending or pathologic fractures between 1993 and 2009 (Table 1). There were 10 men and six women with a mean age of 60 years (range, 40–78 years). One patient who underwent a distal femoral replacement at the time of the simultaneous nailing procedure was excluded. The remaining 16 patients underwent 33 nailings. The medical charts were reviewed for the occurrence of perioperative mortality and signs or symptoms of pulmonary compromise. The nailings included 15 femurs, 17 humeri, and one tibia. Five patients had two impending fractures, two had two pathologic fractures, eight had a combination of one impending and one pathologic fracture, and one had two impending fractures and one pathologic fracture. Thirty-one of the nailings were reamed. The only two unreamed nailings were pathologic fractures of the humerus. The minimum followup was 1 month (mean, 11 months; range, 1–67 months).

Five patients (nine long bones) had venting of the canal or curettage of the metastatic lesion before nailing. Of the 20 impending fractures, there were five curettages and two venting procedures done before reaming. Two pathologic fractures were curetted before reaming. Of the five patients with multiple impending fractures, one underwent venting of the femur and a second underwent venting of the femur and curettage of the humerus before nailing.

Four nonpulmonary complications occurred in four separate patients during the postoperative period. These included postoperative ileus, transient chest pain, myocardial infarction, and atrial fibrillation. All recovered and were discharged after appropriate medical management.

Results

Three patients died before being discharged. Two of these deaths were presumed to be the direct result of acute pulmonary complications related to simultaneous nailing. One of the three patients died intraoperatively. The mean postoperative survival for patients who died before discharge was 13.6 days (range, 0–26 days).

Of the 13 patients who survived after being discharged, three had pulmonary complications. Two patients were kept intubated postoperatively and were extubated on postoperative Days 1 and 2. Neither of these patients had pulmonary issues develop after extubation. The third patient had one episode of shortness of breath on postoperative Day 1. A workup for pulmonary embolus was

Table 1. Patient summary

Patient	Age (years)	Gender	Diagnosis	Impending	Pathologic	Postoperative survival
1	58	M	Urothelial	Femur, femur	No	> 4 weeks
2	69	M	Liver	No	Humerus, humerus	8 weeks
3	59	M	Lung	Femur, humerus	No	4 weeks
4	57	M	Myeloma	Femur, humerus	No	23 weeks
5	44	F	Myeloma	No	Femur, humerus	16 weeks
6	68	M	Esophageal	Femur, femur	Humerus	2 weeks*
7	40	F	Breast	Femur	Humerus	0*
8	55	M	Renal	Humerus	Femur	11 weeks
9	57	F	Lymphoma	Humerus	Femur	20 weeks
10	59	M	Myeloma	Tibia	Humerus	48 weeks
11	53	F	Breast	Femur, humerus	No	4 weeks
12	56	F	Myeloma	Humerus	Humerus	Unknown
13	69	M	Renal	Humerus	Femur	271 weeks
14	70	M	Renal	Femur	Humerus	26 days*
15	72	F	Breast	Femur	Humerus	24 weeks
16	78	M	Prostate	Femur, humerus	No	52 weeks

* Died before discharge.

negative, and the patient improved with aerosol breathing treatments. Eleven patients had documented dates of death. The mean postoperative survival for discharged patients was 43.8 weeks (range, 4–271 weeks).

Among the five patients with an impending fracture, we observed two pulmonary complications. One patient was kept intubated overnight and a second had one episode of shortness of breath, described above. There were no intraoperative or perioperative deaths in this group.

The death that occurred intraoperatively was the result of a massive pulmonary embolus. The patient had considerable metastatic involvement of the spine and underwent a T5-T6 vertebrectomy and fusion 13 days before her simultaneous nailings. The pulmonary embolus occurred during the second nailing. The second patient was the only one in the series to undergo three nailings. The patient had respiratory distress develop in the recovery room from presumed fat emboli and died on postoperative Day 15. The third patient was bedridden preoperatively. On postoperative Day 18, the patient had pneumonia of the left lower lobe develop which led to acute renal failure and death on postoperative Day 26.

Discussion

In the orthopaedic oncology literature, some authors have cautioned against performing simultaneous nailing of metastatic lesions [3, 7–10]. However, a review of the literature reveals that this concept is based on studies of a relatively small number of patients who typically were intermingled with reports of single nailings. Even with such little support in the literature, the recommendation for performing multiple nailings in a staged fashion, the use of unreamed nails, and venting has developed. The purpose of our study was to evaluate the pulmonary mortality and morbidity of patients undergoing simultaneous nailing. We presumed that the mortality rates were not as high as reported [7]. In addition, we evaluated simultaneous nailing of impending fractures as a separate group to determine if these patients were in a higher risk group.

We note limitations of our study. First is the small study size. However, as the need for simultaneous nailing is an uncommon event, the retrospective design and small study size would be difficult to avoid. Second, we lacked a control group of patients treated with staged fixation. Third, selection bias was unavoidable. It is likely that only patients who potentially were more medically fit and better able to withstand the inevitable production of emboli were selected for simultaneous nailing. Patient selection is likely a major contributor to avoiding a higher mortality rate and therefore we believe the selection bias is appropriate.

The primary concern for this patient population is perioperative death resulting from tumor, fat, thrombotic, or air emboli and subsequent pulmonary dysfunction. Intuitively this seems a reasonable concern given that these patients are subject to a potentially higher volume of tumor emboli and presumably would have more advanced disease and would be less medically fit than patients who require only a single nailing. Therefore, the primary question that was posed with this review is: do patients undergoing simultaneous nailings have a substantially high perioperative pulmonary morbidity or mortality? There were three perioperative deaths. Although three of 16 patients reflects a high rate, it is similar to the perioperative mortality reported in series that predominately were regarding single nailings [2, 4–6, 11], which range from 0% to 17%. As perioperative deaths can result from a multitude of causes, examining the intraoperative death rate may be a better gauge for evaluating the risk of an acute embolic event during simultaneous nailings. Of our three perioperative deaths, one occurred intraoperatively. Our intraoperative death rate of 6% is comparable to that of reports of primarily single nailings for impending and pathologic fractures, which range from 0% to 10% [1, 2, 5, 6].

We observed no deaths in the group of five patients with impending fractures. This subgroup of patients was identified by Kerr et al. [7] as having the highest risk of intraoperative death, which prompted their recommendation of staging multiple nailings. They reported intraoperative mortality in (two of three patients) treated with staged bilateral nailings, but the one patient who survived and who had bilateral nailings was not staged. The low rate of mortality in our impending fracture group occurred despite the fact that all nails were reamed and the majority of long bones were not vented. The low number of patients who were treated with simultaneous nailing in the study by Kerr et al. [7] likely led to an overestimation of mortality and would explain the substantial difference in our findings.

The two deaths that were directly attributable to acute pulmonary compromise suggest that careful patient selection is likely an important factor in patient outcome. Both cases appear to be outliers when compared with patients who survived. The first patient's clinical course strongly suggested a massive saddle thrombus that stopped all pulmonary perfusion. In hindsight, prevention of this complication might have been accomplished with a high index of suspicion for venous thromboembolic disease, preoperative venogram, and possibly inferior vena caval filter placement. It is uncertain whether staging the nailings alone could have prevented the massive pulmonary embolus. The second patient was the only one in the series to have three nailings, and appeared to have fat embolism syndrome develop. This suggests there may be a threshold

Table 2. Literature comparison

Study	Number of patients	Unilateral nailing	Simultaneous nailing	Perioperative deaths	Intraoperative deaths
Assal et al. [1] 2000	10	10	0	*	10%
Barwood et al. [2] 2000	43	43	0	11%	7%
Christie et al. [4] 1995	19	19	0	11%	*
Cole et al. [5] 2000	65	65	0	8%	3%
Giannoudis et al. [6] 1999	27	24	3	0%	0%
Kerr et al. [7] 1993	23	22	1	17%	9% overall 67% impending
van Doorn & Stapert [11] 2000	101	92	9	14%	*
Current study	16	0	16	19%	6% overall, 0% impending

* Unable to determine.

beyond two simultaneous nailings that increases the likelihood of complications from fat embolism.

Although the rate of perioperative mortality for simultaneous nailing of skeletal metastasis is high, our mortality rates are not markedly different from those of series of unilateral nailings and are lower than those of previous reports of simultaneous nailings (Table 2) [2, 4–7, 11]. Although simultaneous nailing should be approached with caution, our findings do not support previous recommendations of the mandatory staging of multiple nailings. Contrary to previous reports, patients with impending fractures did not appear to be in a higher risk group than patients with pathologic fractures.

References

1. Assal M, Zanone X, Peter RE. Osteosynthesis of metastatic lesions of the proximal femur with a solid femoral nail and interlocking spiral blade inserted without reaming. *J Orthop Trauma*. 2000;14:394–397.
2. Barwood SA, Wilson JL, Molnar RR, Choong PF. The incidence of acute cardiorespiratory and vascular dysfunction following intramedullary nail fixation of femoral metastasis. *Acta Orthop Scand*. 2000;71:147–52.
3. Charnley G, Coleman NP, Hashemi-Nejad A. Cardiac arrest during nailing. *J Bone Joint Surg Br*. 1994;76:506.
4. Christie J, Robinson CM, Pell AC, McBirnie J, Burnett R. Transcardiac echocardiography during invasive intramedullary procedures. *J Bone Joint Surg Br*. 1995;77:450–455.
5. Cole AS, Hill GA, Theologis TN, Gibbons CL, Willett K. Femoral nailing for metastatic disease of the femur: a comparison of reamed and unreamed femoral nailing. *Injury*. 2000;31:25–31.
6. Giannoudis PV, Bastawrous SS, Bunola JA, Macdonald DA, Smith RM. Unreamed intramedullary nailing for pathological femoral fractures: good results in 30 cases. *Acta Orthop Scand*. 1999;70:29–32.
7. Kerr PS, Jackson M, Atkins RM. Cardiac arrest during intramedullary nailing for femoral metastases. *J Bone Joint Surg Br*. 1993;75:972–973.
8. Kontakis GM, Tossounidis T, Weiss K, Pape H-C, Giannoudis PV. Fat embolism: special situations Bilateral femoral fractures and pathologic femoral fractures. *Injury*. 2006;37(suppl):S19–S24.
9. Peter RE, Schopfer A, Le Coultre B, Hoffmeyer P. Fat embolism and death during prophylactic osteosynthesis of a metastatic femur using an unreamed nail. *J Orthop Trauma*. 1997;11:233–234.
10. Roumen RM, Lako SJ, Schoots FJ. Acute lung damage after bilateral insertion of femoral intramedullary interlocking nails for metastatic bone disease. *Eur J Surg*. 1995;161:451–453.
11. van Doorn R, Stapert JW. Treatment of impending and actual pathological femoral fractures with the long Gamma nail in the Netherlands. *Eur J Surg*. 2000;166:247–254.