



The “Friday peak” in surgical referrals for spinal metastases: lessons not learned. A retrospective analysis of 201 consecutive cases at a tertiary center

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Abstract

Background Spinal cord compression and fracture are potential complications of spine metastasis (SM). Rapid management by an expert team can reduce these adverse developments. Delays in seeking therapeutic advices, which lead to the need for sub-optimal emergency procedures, were already demonstrated nearly 20 years ago. We aimed to analyze the current weak points of referrals for vertebral metastasis so as to improve the care pathways.

Methods We retrospectively reviewed the data of all patients admitted on an emergency or elective basis who underwent palliative surgery for the treatment of neoplastic spine lesions in our institution (tertiary referral neurosurgical unit) between January 2009 and December 2016.

Results This retrospective study included 201 patients, 121 men and 80 women (mean age 65.1 years \pm 10.9). Cancer was known for 59.7% of cases. Patients were neurologically asymptomatic in 52.7% of cases (Frankel E), and 123 (60.7%) were hospitalized for emergency reasons, including 51 (41.5% of emergencies) on a Friday ($p < 0.0001$). A significant increase in emergencies occurred over the studied period ($p = 0.0027$). The “emergency” group had significantly unfavorable results in terms of neurological status ($p < 0.001$), the occurrence of complications ($p = 0.04$), the duration of hospitalization ($p = 0.02$), and the clinical evolution ($p = 0.04$). Among 123 patients hospitalized for emergency reasons, 65 (52.8%) had known cancers, of which 33 had an identified SM, including 22 with neurological deficits (Frankel A–D), without prior surgical assessment (17.8% of emergencies).

Conclusion Too many patients with previously identified metastases are referred for emergency reasons, including with a neurological deficit. Optimizing upstream pathways and referrals is imperative for improving the management of these patients. Involving a spine surgeon at the slightest symptom or an abnormal image is critical for defining the best treatment upstream. The use of telemedicine and the development of dedicated tumor boards are ways of improving this involvement.

Keywords Spine · Tumor · Metastasis · Spinal cord compression · Multidisciplinary meeting · Tumor board · Referral · Spine surgery · Decompression · Emergency

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Abbreviations and acronyms

EBM	Evidence-based medicine
KPS	Karnofsky performance status
LOS	Length of stay
MRI	Magnetic resonance imaging
SM	Spinal metastasis

Introduction

The spine is the main site of bone metastasis, and some cancers (lung, breast, prostate, etc.) have an elective affinity for this location [2]. Symptomatic metastasis is estimated to occur in up to 10% of all cancer patients [25]. Considering longer life expectancy and improvements in cancer treatment optimized by multidisciplinary approaches, the incidence of spinal metastasis (SM) is expected to rise. Nowadays, vertebral metastases appear for primitives, which a few years ago did not give bone locations, due to a shorter life expectancy at the time [3].

Axial or radicular pain occurs in up to 80% of patients with SM. Moreover, neurologic compression occurs in up to 20% of patients with pre-existing SM and in 5 to 10% of all patients with cancer [28]. Physicians face a dual challenge: controlling pain and avoiding neurological threat, which has a direct impact on the quality of life of patients, whose survival is often limited [19].

The therapeutic arsenal has recently evolved: chemotherapy (including targeted molecular drugs), radiotherapy, and hormonal therapies, with an obvious effect on survival rates. Surgery has also been at the center of many advances, particularly minimally invasive surgery, by playing on the mechanical stability and decompression of neurological structures [29].

Ideally, this multidisciplinary care should be planned upstream [3]. Tumor boards may have an advantage to avoid having to do so in an emergency [11]. Nevertheless, these organizations are not available in all care systems or in all regions.

In fact, if the neurological deterioration is rapid and/or recent, urgent recourse to surgery is generally necessary, and as a consequence, the problem of the therapeutic choice arises [5, 10]. Such emergency interventions carry a certain morbidity; in particular, the installed deficit does not always recover in an optimal way [5].

The empirical experience of many teams (which was documented at the turn of the century) [4, 18, 21] is that an emergency referral peak could occur on Fridays. This implies problems of clinical evaluation, imaging access, and the organization of oncological follow-up upstream of the surgical department. Beyond the anecdotic claim of “Always on a Fridays!” [21], the aim of our study was to verify if this situation identified over the past 20 years has changed, by analyzing the

contexts of the referral and management of these patients in our institution, particularly in emergency situations. Our goal was to develop a more general hypothesis regarding the healthcare pathway and the organization of upstream oncological management, as well as to draw attention to necessary changes.

Patients and methods

This retrospective cohort study included all patients who presented to our institution from January 1, 2009 to December 31, 2016, with bony SM requiring palliative surgical intervention. Our center is a tertiary referral neurosurgical unit, but without tumor board specifically dedicated to vertebral metastases. In our region of more than 3 million inhabitants, our structure takes care of elective or urgent patients from all corresponding private or public centers without selection. The surgical activity of our department (> 3500 cases per year) represents on average 45% of the total activity of the five spinal surgery centers in our region, including university hospitals, over the last 3 years. These data concern a case mix perfectly comparable between institutions including traumatology and spinal oncology, regardless of the severity of the cases [30].

All patients surgically treated for SM with a known or unknown primary neoplasm, whatever their neurologic statuses may have been, were included in the study. Exclusion criteria included primitive spine tumor, patients with SM who did not undergo surgical treatment, patients who had vertebroplasty procedure without decompression, or patients who underwent excisional surgery, the management of which is dramatically different.

Clinical and radiological characteristics

The clinical records of patients were retrospectively analyzed. Age, sex, clinical signs, Karnofsky performance status (KPS), radiological findings, and histopathological results were systematically recorded in the medical records. Neurological status was evaluated using the Frankel classification [6]. We posteriorly evaluated the patients according to the Tokuhashi score [27]. We investigated whether the lesion was revealing or if the patient suffered from a known neoplasm, and in that case, we checked the length of evolution of the primitive disease and if a spinal metastasis was already identified and had already received a surgical proposal before the referral to our institution.

Referral description

We analyzed the referrals of the patients and divided them effectively into two groups: “elective” (i.e., referred to a

scheduled consultation) and “emergency” (by direct call to the on-call surgeon from a physician or a corresponding institution from our region, including internal or external emergency department). For patients referred for emergency reasons, we recorded the day of the referral.

Group comparisons

To evaluate the clinical statuses, the referral patterns, the management delays, and the evolution, we compared the two groups, focusing on the following parameters: revealing metastasis, evolution before referrals (days), Frankel classification, Tokuhashi score, delay of surgery (days), length of stay (LOS), complications, and day-90 evolution (death, total or important improvement, significant or partial improvement, no improvement).

Our study focused on emergency referrals, specifically on the Friday referrals, so we compared emergency patients from this specific day with emergency patients from all of the other days in order to detect a specific pattern of these daily referrals.

Statistical analysis

Descriptive analyses were initially performed. Continuous data were then expressed as means, and qualitative data as frequencies. Comparisons of distributions were realized using the Wilcoxon test, and comparisons of frequencies were made using the chi-squared test or Fisher’s exact test if chi-squared was not valid.

Comparisons of frequencies over time were performed using the Cochran-Armitage trend test.

To detect if Friday reflected the highest referrals among the overall sample, a chi-squared goodness of fit test was conducted. Statistical analyses were performed using the SAS System v9.3, Cary, NC, USA. The significance level was set to 0.05.

Results

Population characteristics

The main demographical data are summarized in Table 1. Between 2009 and 2016, 201 patients were included in this study. There were 121 men and 80 women, with a mean age at diagnosis of 65.1 years (range 28–88 years). The mean KPS was 88 (range 50–100). With regard to the Tokuhashi score, 73 patients (26.3%) had scores inferior or equal to 8, 99 (49.3%) had scores between 9 and 12, and 29 (14.4%) had scores superior or equal to 12. At the time of admission, the histological diagnosis was unknown in 69 patients (34.3%). The two most frequently

Table 1 Main demographical data ($n = 201$, 2009–2016)

Variable	Values
Nombre	201
Age	65.13 (28–88)
Gender	
Male	121 (60.2%)
Female	80 (39.9%)
KPS	
Poor (10–40%)	2 (1.0%)
Moderate (50–70%)	30 (14.9%)
Good (80–100%)	169 (84.1%)
Histology	
Breast	30 (14.9%)
Lung	30 (14.9%)
Prostate	20 (10.0%)
Kidney	12 (6.0%)
Bowel	8 (4.0%)
Bladder	4 (2.0%)
Others	28 (13.9%)
Unknown	69 (34.3%)
Level	
Upper cervical	3 (1.5%)
Lower cervical	22 (10.9%)
Upper thoracic	57 (28.4%)
Lower thoracic	66 (32.8%)
Lumbar/ sacral	53 (26.4%)
Diagnosis	
Pain	113 (56.2%)
Neuro	88 (43.8%)
Evolution before referrals (days)	
< 2 days	23 (11.4%)
2–7 days	18 (9.0%)
8–30 days	92 (45.9%)
31–60 days	30 (14.9%)
> 60 days	38 (18.9%)
Frankel ^a	
A	4 (2.0%)
B	14 (7.0%)
C	25 (12.4%)
D	52 (25.9%)
E	106 (52.7%)
Tokuhashi ^b	
Score ≤ 8	73 (26.3%)
9 < score < 12	99 (49.3%)
Score ≥ 12	29 (14.4%)

KPS Karnofsky performance status

^a Frankel classification interpretation. A—complete: no motor or sensory function. B—incomplete: sensory present, motor function absent. C—incomplete: sensory present, motor function present but not useful (grade 2 or 3/5). D—incomplete: sensory present, motor function present and useful (grade 4/5). E—normal: sensory and motor function

^b Tokuhashi score interpretation. Score ≤ 8: life expectancy < 6 months. 9 ≤ score < 12: life expectancy 6–12 months. Score ≥ 12: life expectancy > 12 months

known primitive cancers were breast and lung: 30 patients for each (14.9%).

Clinical and radiological findings

Metastasis revealed the disease for 81 patients (40.3%), whereas 120 patients (59.7%) had known cancers. The

symptoms leading to the discovery of vertebral metastasis were pain in 113 patients (56.2%) and neurological deficit in 88 (43.8%). The symptomatology before referrals was inferior to 7 days in 20.4% of cases and was superior to 60 days in 79.6%. The symptomatic metastasis occurred in cervical spine in 25 patients (12.4%), in the thoracic spine in 123 patients (61.2%), and in the lumbosacral spine in 53 patients (26.4%). With regard to the Frankel classification, 106 patients (52.7%) had normal sensory and motor function (Frankel E) and 43 (21.4%) were not ambulatory on admission (Frankel A–C).

For patients with known primary cancers, the mean follow-up period was 3.9 years (0–20).

Time pattern of referrals

Patients were referred by the medical oncology or radiotherapy departments in 53.2% of cases, by internal medicine departments in 21.4% of cases, by their general practitioners in 16.4% of cases, and by emergency departments in 9.0% of cases. Thirty-one (15.4%) patients received internal referral from our institution.

Among 201 patients, 123 (60.7%) were referred for emergencies and 78 (39.3%) were referred for elective reasons (Fig. 1). We confirmed that the percentage of patients treated for emergency reasons in our institution increased significantly over the period under review (Cochran–Armitage trend test, $p = 0.0027$).

The distribution of the referral of emergency patients ($n = 123$) throughout the days of the week is presented in Fig. 2. Significantly more referrals took place on Friday than on the other weekdays: 41.5% vs. 9.8–16.3%. Only a few referrals took place during the weekend: 5.7% on Saturday and Sunday combined. The difference between Friday and the other days

of the week was significant (chi-squared goodness-of-fit test, $p < 0.0001$).

Comparison between emergency and elective groups

The comparative data of the two groups are reported in Table 2. All of the data studied were significantly different for the two groups. The “emergency group” included more revealing metastases compared with the elective group (47.2% vs. 29.5%), with a shorter evolution course before referrals (average 33.1 days vs. 60.8), more neurological deficits (61.87% vs. 24.4%), lower Tokuhashi scores, a shorter delay for surgery (2.3 days vs. 8.6 days, a longer LOS (10.6 days vs. 8.5 days), a higher rate of complications (30.9% vs. 17.9%), and a higher rate of unfavorable evolution, including more day-90 mortality (13% vs. 7.7%).

For emergency inpatients, the Friday group did not differ significantly from the inpatient groups on the other days (Table 3), particularly regarding the existence of a neurological deficit at admission (60.8% vs. 62.5%), the delay before surgery after admission (2.6 days vs. 2.1 days), and the occurrence of complications (35.3% vs. 26.4%).

Oncological pathways of emergency inpatients

Among the patients hospitalized for emergency reasons, including 65 with primitive cancer already identified (Fig. 3). Of these 65 patients, 33 had vertebral metastases already identified, and among these 33 patients, 22 (66% with known metastases, 17.8% of emergencies) had neurological defects upon admission (Frankel A–D). None of these 22 patients received consultations from a spinal surgeon before their emergency referrals.

Fig. 1 Emergency vs. elective referrals of patients with vertebral metastasis by year (2009–2016)

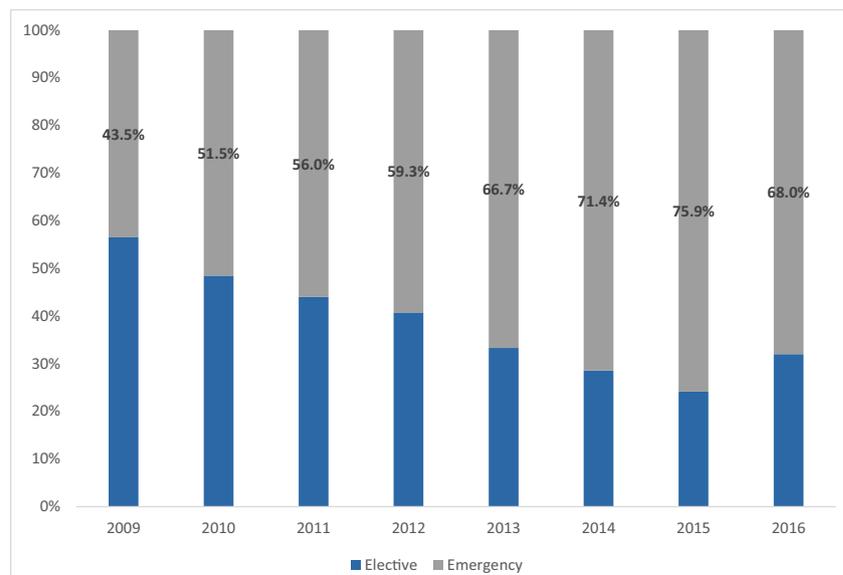
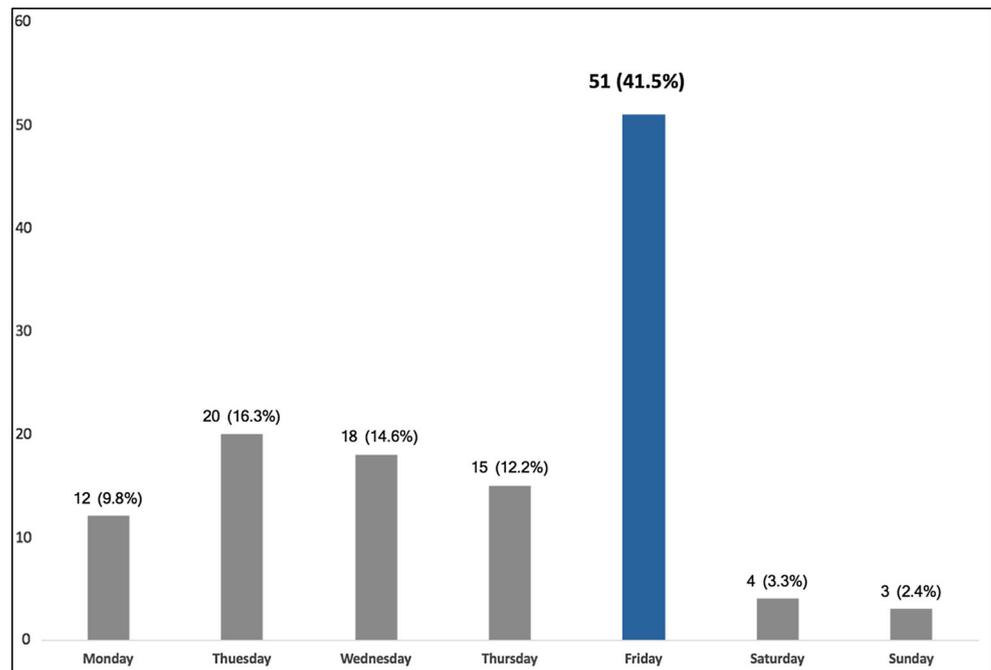


Fig. 2 Referral days for emergency patients admitted for vertebral metastasis by day of week ($n = 123$)



Discussion

Main results

In our study, 60.7% of patients were hospitalized for emergency reasons (demonstrating a significant increase

in emergencies over the studied period), including 41.5% referred on a Friday. The emergency group had significantly unfavorable results (neurological status, occurrence of complications, LOS, and neurological progression). In the emergency group, 22 patients with known metastases (17.8% of emergencies) had neurological defects upon

Table 2 Comparison between the group “elective” and the group “emergency”

	Elective group, $n = 78$ (%)	Emergency group, $n = 123$ (%)	p
Revealing metastasis	23 (29.5%)	58 (47.2%)	0.02
Evolution before referrals (days)	60.8 (2–365)	33.1 (1–180)	< 0.001
Frankel ^a A–D	19 (24.4%)	76 (61.8%)	< 0.001
Frankel E	59 (75.6%)	47 (38.2%)	
Tokuhashi Score ^b			
Score ≤ 8	23 (29.5)	50 (40.7)	0.03
$9 < \text{score} < 12$	45 (57.7)	68 (55.3)	
Score ≥ 12	10 (12.8)	5 (4.1)	
Delay to surgery (days)	8.6 ± 7.8	2.3 ± 3.7	< 0.001
Length of stay (days)	8.5 ± 5.0	10.6 ± 7.0	0.02
Complications	14 (17.9)	38 (30.9)	0.04
Clinical follow-up (third month)			0.03
Death	6 (7.7)	16 (13.0)	
Complete or significant improvement	36 (46.2)	36 (29.3)	
Partial or moderate improvement	21 (26.9)	31 (25.2)	
Poor or no improvement	15 (19.2)	40 (32.5)	

^a Frankel classification interpretation. A—complete: no motor or sensory function. B—incomplete: sensory present, motor function absent. C—incomplete: sensory present, motor function present but not useful (grade 2 or 3/5). D—incomplete: sensory present, motor function present and useful (grade 4/5). E—normal: sensory and motor function

^b Tokuhashi score interpretation. Score ≤ 8 : life expectancy < 6 months. $9 \leq \text{score} < 12$: life expectancy 6–12 months. Score ≥ 12 : life expectancy > 12 months

Table 3 Patients referred in emergencies, comparison between Friday and other days of week ($n = 123$)

	Friday emergencies ($n = 51$)	Other day emergencies ($n = 72$)	<i>p</i>
Evolution before referrals (days)	35.1 (1–180)	31.7 (1–180)	0.7
Revealing metastasis	25 (49.0%)	33 (45.8%)	0.24
Frankel ^a E	20 (39.2%)	27 (37.5%)	0.84
Frankel A–D	31 (60.8%)	45 (62.5%)	
Tokuhashi score ^b	8.7 (3–13)	8.8 (3–13)	0.6
Delay to surgery (days)	2.6 (0–19)	2.1 (0–21)	0.5
Length of stay (days)	9.8 (2–39)	11.2 (2–45)	0.2
Complications	18 (35.3%)	19 (26.4%)	0.4

^a Frankel classification interpretation. A—complete: no motor or sensory function. B—incomplete: sensory present, motor function absent. C—incomplete: sensory present, motor function present but not useful (grade 2 or 3/5). D—incomplete: sensory present, motor function present and useful (grade 4/5). E—normal: sensory and motor function

^b Tokuhashi score interpretation. Score ≤ 8 : life expectancy < 6 months. $9 \leq$ score < 12: life expectancy 6–12 months. Score ≥ 12 : life expectancy > 12 months

admission (Frankel A–D), with no previous surgical consultations.

Hypothesis on patient pathway's delay

Before Patchell's study [20], which put surgery back at the forefront of SM management, some radiotherapists had already noticed this overload of patients transferred to their departments just before weekends. Poortmans et al. rightly asked this provocative question in 2001: "Always on Friday?" [21]. They found that 26.3% of all referrals occurred on Fridays, which was significantly more than on all other weekdays. In 2013, although many authors highlighted the need for rapid diagnosis and treatment to maintain ambulatory status [13, 15], the same team noted that a delay in treatment continued to exist [14].

In the case of a patient referred for emergency reasons, the surgeon on duty is faced with a complex decision, and most of the time without access to complete data on the patient's condition, regarding the vital prognosis and the therapies involved (which can also have adverse effects in the event of surgery, including hemorrhage) [1, 25, 28]. It is also difficult in some institutions to obtain emergency magnetic resonance imaging (MRI) after hours [8, 16, 21]. Finally, performing "after-hours" spinal oncologic surgery may in some cases carry risks that would not be the same in a program set up with a trained team [7, 22].

Unfortunately, the clinical material and data at our disposal did not allow us to define a specific cause for each patient concerning this Friday peak: it was impossible to obtain sensitive data from the addressing departments. We have therefore formulated some non-exhaustive hypotheses: deficient organization of departments, insufficient clinical evaluation of patients, delay in the completion of MRI, absence of dedicated tumor board, etc. Even if we cannot provide a quantitative answer to this situation, the Friday peak remains, in our

opinion, the symbol of a disorganization of the entire oncological management at each level.

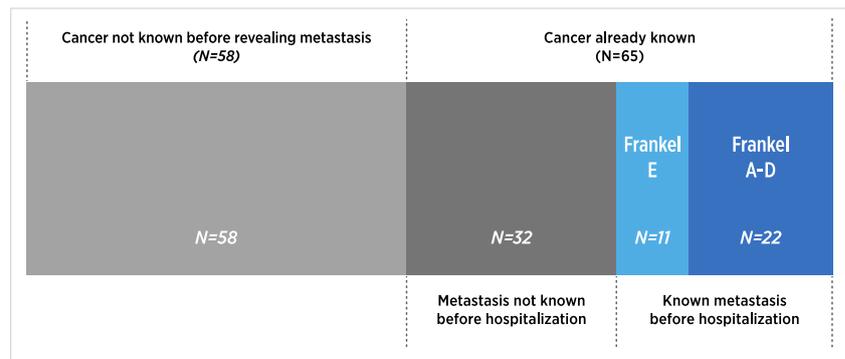
Beyond Friday: referral pattern in emergency

The patient (and family) remains the master of his or her own story, which can delay admission in an emergency due to ignorance regarding the disease, its developments, and its consequences [14]. This lack of knowledge can sometimes be extended to general practitioners or referring specialists despite the existence of boards. In 2002, Levack et al. challenged the medical community in his prospective audit entitled: "Don't wait for a sensory level—listen to the symptoms!" [16]. The elementary need for a high-quality daily clinical examination may seem obvious, but in an ultra-technological universe, this basic requirement is often neglected [24]. It is also possible that the physician who is preparing to take charge on the weekend may have a different evaluation of patients hospitalized for several days [21]. Once again, difficulty in gaining rapid access to MRI, specifically outside of normal working hours, at night, and on weekends, can undoubtedly be blamed [23].

Tumor board organization

A tumor board dedicated to vertebral metastases can optimize the management of these patients. In 2015, Zairi et al. showed that since the establishment of such a board in his institution, the percentage of metastases of known cancers operated on in emergency situations decreased significantly [28]. In the absence of such an organization, we report the opposite experience. Such meetings dedicated to the metastatic spine are rare, and in many countries, boards are organized by "primitive organs," without a spine surgeon being present at each meeting. Medical decisions are therefore not always validated by a specialist in vertebral surgery [7]. Moreover, several authors

Fig. 3 Neurological status of emergency patients with spinal metastasis ($n = 123$)



observed little association of multidisciplinary tumor boards with measures of use, quality, or survival [12].

The need for early involvement of surgeons

Some patients, refusing any medical care, will ineluctably continue to arrive with synchronous diagnoses of cancer, SM, and neurological deficits. However, it is not acceptable in a care pathway to receive a patient in emergency who is already managed by a tumor board with an identified neurological threat, and who has not received surgical consultation before an urgent event [13, 20]. Upstream management by a dedicated board could make it possible to harmonize practices, thus disproving Galasko's pessimistic conclusion in 2000 that surgeons failed to educate their colleagues in other specialties about the principles of the management of spinal instability secondary to the metastatic disease of the spine [10]. However, for obvious reasons, the presence of a surgeon at every meeting (on a regional scale) is illusory in terms of planning, but technical innovations can be implemented to allow the surgeon to participate even in an off-site way in decision-making [26]. The potential of telemedicine, already applied to other "virtual" oncology meetings, seems very promising in the field of vertebral metastatic pathology [17]. Finally, we reiterate an old plea that any painful or deficit symptoms on the one hand, and any abnormal spinal image on the other hand, should be reported to a surgeon as early as possible, even if this does not necessarily mean that an operation is required [16].

Bias and limitations

The main limitation of this study is that it remains mono-institutional, and therefore, the generalization of its conclusions should be carefully considered. That said, the data on the activity of our institution within our region, as well as its wide recruitment, seems to us to represent a general organization in our country, where the existence of tumor boards dedicated to vertebral metastases is extremely rare as attested by other teams [28]. Other authors have also made similar

findings before us in various countries and health systems [9, 14, 16]. Finally, it was impossible to fully analyze the causes of surgical addressing delays, as information on the organizational aspect of other departments upstream of ours was almost impossible to objectively highlight. However, like Poortmans et al. before us [21], we made some basic assumptions about these delays.

Conclusion

Our study demonstrated an emergency referral peak of vertebral metastasis on Fridays. More generally, patients urgently transferred because the negative impact of delayed treatment on the chances of recovery from neurological syndromes showed unfavorable trends in terms of morbidity and mortality. Upstream optimization methods exist to limit emergency hospitalizations on Fridays and other days. Unfortunately, they were already proposed more than 20 years ago, without many changes since then. The basic neurological training of clinicians, better access to MRI, the optimization of the communication of medical information between institutions, and the involvement of spine surgeons on tumor boards are some of the options to explore in order to improve the quality of life of these patients, whose survival is often limited.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study formal consent is not required.

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