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Does Magnetic Resonance Imaging (MRI) Make a Difference in the Management of Patients with Cancer Admitted to the Emergency Room?

A ressonância magnética faz diferença no manejo do paciente oncológico admitido na emergência?

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ABSTRACT

Imaging examinations play a fundamental role in the evaluation of neoplasms and their complications. The objective of this study was to evaluate the role of magnetic resonance imaging (MRI) in the urgent care and emergency department of a cancer referral center, with identification of its main indications and findings and their effects on therapeutic management and decision making. Retrospective analytical study, which involves reviewing medical records and imaging reports for all patients who were identified on MRI scans in the urgency or emergency between June 2017 and June 2018 in the imaging department. 317 revised MRI reports were included in the analysis. MRI was performed to investigate metastases and complications related to the underlying disease in 246 (77.6%) cases and in 71 (22.4%) to explore the clinical reasons presented during emergency care. The findings were positive (confirming suspicious indications) in 211 (66.6%) cases and negative in 106 (33.4%). No patient died during hospitalization. The main indication for MRI in this sample was the investigation of complications related to the underlying diseases. The most frequently requested MRI examinations were of the skull and spine. Hospitalization was the most frequent measure taken after MRI examination in the emergency room.

Keywords: Magnetic resonance imaging; Emergency; Oncology.

RESUMO

Os exames de imagem têm papel fundamental na avaliação das neoplasias e suas complicações. O objetivo deste estudo foi avaliar o papel da ressonância magnética (RM) no atendimento de urgência e emergência de um centro de referência em câncer, identificando suas principais indicações, achados e seus efeitos no manejo terapêutico e na tomada de decisão. Estudo analítico retrospectivo, que envolve a revisão de registros médicos e relatórios de imagem para todos os pacientes que foram identificados em exames de ressonância magnética na urgência ou emergência entre junho de 2017 e junho de 2018 no departamento de imagem do centro oncológico. 317 relatórios revisados de ressonância magnética foram incluídos na análise. A ressonância magnética foi realizada para investigar metástases e complicações relacionadas à doença de base em 246 (77,6%) casos e em 71 (22,4%) para explorar os motivos clínicos apresentados durante o atendimento de emergência. Os achados foram positivos (confirmando indicações suspeitas) em 211 (66,6%) casos e negativos em 106 (33,4%). Nenhum paciente morreu durante a hospitalização. A principal indicação de RM nesta amostra foi a investigação de complicações relacionadas às doenças de base. Os exames de ressonância magnética mais solicitados foram de crânio e coluna vertebral. A hospitalização foi a medida mais frequente após exame de ressonância magnética em pronto-socorro.

Palavras-chave: Imagem por Ressonância Magnética; Emergências; Oncologia.

INTRODUCTION

The World Health Organization projects that 21.4 million new cases of cancer and 13.2 million cancer-related deaths will occur in 2030 due to population growth.¹ Early detection and the development of more effective treatments increase the survival of patients with cancer, and thus the numbers of these patients presenting for urgent and emergency care.²⁻³ Associated with significant developments in diagnostic techniques and therapeutic approaches, supportive clinical care is a main contributor to the improvement of patients' quality of life.⁴

Imaging is of great importance in the evaluation of neoplasia and its complications; it provides valuable information enabling better management of patients with cancer. It can be used during several stages of care, ranging from screening to post-treatment follow-up.⁵ Although not always used as the first-line imaging modality in emergency departments, magnetic resonance imaging (MRI) can be valuable in the diagnosis and treatment of emergent conditions.⁶ Its advantages include the absence of ionizing radiation and superior visualization of soft-tissue contrast relative to other imaging techniques.⁷⁻⁸

Over the past 25 years, MRI has developed considerably and become popular. With the advancement of technologies used in radiology and diagnostic imaging, MRI has become an established modality in clinical practice with a high capacity for tissue differentiation, allowing its application in anatomical and functional exploration in all parts of the human body. As MRI is available in many specialized and unspecialized centers, it is being used increasingly in urgent care and for oncological emergencies.⁹

Cancer complications can be classified as direct and indirect effects of tumors. Direct effects include invasion and mechanical compression of structures adjacent to a tumor, and indirect effects include systemic manifestations of the disease.¹⁰ Among the main acute oncological complications are neurological complications (e.g., spinal cord compression syndrome), thoracic disorders (e.g., superior vena cava syndrome), and abdominal disorders (e.g., intestinal obstruction).¹¹ In view of the main oncological urgencies and emergencies, and given the fundamental role of imaging examinations in the evaluation of neoplasms and their complications, we describe the experience at an oncological reference center of MRI indication in urgent and emergent cases, the main MRI

findings, and the effects of MRI use on therapeutic conduct and decision making, with the correlation of indications with rates of hospital admission and mortality during hospitalization.

MATERIAL AND METHODS

This analytical, retrospective study involved the review of imaging examination reports and medical records of all patients who underwent MRI examinations requested by the emergency department during urgent and emergent care at the A.C. Camargo Cancer Center's (ACCCC's) Imaging Department between June 2017 and June 2018. The following inclusion criteria were used: admission to and monitoring at the ACCCC and confirmed cancer diagnosis. The exclusion criteria were: presence of imaging artifacts, and magnetic susceptibility hindering image analysis. Demographic, clinical, and radiological data were collected from MRI examinations available in the center's radiology information system and patients' electronic medical records using a standardized form. The data were analyzed using the SPSS software (version 25; IBM Corporation, Armonk, NY, USA). The Research Ethics Committee of the ACCCC approved this research project (number: 2.799.047).

RESULTS

Of 1,532 MRI reports reviewed, 317 met the inclusion criteria; these cases were included in the analysis. The average patient age was 57.2 (range, 7–90) years, and 161 (50.8%) patients were female. Patients were classified according to cancer diagnosis; the most common cancers in the sample were malignant neoplasms of the breast [$n = 54$ (17.0%)] and central nervous system [$n = 34$ (10.7%)], malignant melanoma [$n = 30$ (9.5%)], and malignant neoplasms of the prostate [$n = 30$ (9.5%)] (Table 1). The most frequently performed MRI examinations were of the cranium (50.3%), spine (31.2%), and abdomen (7.0%), represented in Table 2. MRI examinations were performed to investigate metastases or complications of the underlying disease in 246 (77.6%) cases and for clinical conditions presenting during emergency care in 71 (22.4%) cases. The most common signs and symptoms in absolute numbers are shown in Table 3.

Table 1. Distribution of oncological diagnoses in the study sample

Diagnosis	n	%
Malignant breast neoplasm	54	17.0
Malignant CNS neoplasm	34	10.7
Malignant melanoma	30	9.5
Malignant prostate neoplasm	30	9.5
Malignant lung neoplasm	28	8.8
Malignant intestinal neoplasm	24	7.6
Malignant uterine neoplasm	14	4.0
Malignant connective-tissue neoplasm	12	3.8
Myeloma	10	3.2
Malignant bladder neoplasm	9	2.8
Malignant pancreatic neoplasm	8	2.5
Malignant kidney neoplasm	7	2.2
Lymphoma	7	2.2
Malignant pharyngeal neoplasm	7	2.2
Malignant ovarian neoplasm	6	1.9
Malignant liver neoplasm	5	1.6
Leukemia	5	1.6
Malignant stomach neoplasm	5	1.6
Malignant neoplasm, no location specification	5	1.6
Malignant thyroid neoplasm	4	1.3
Malignant sinus neoplasm	4	1.3
Malignant vulvar neoplasm	4	1.3
Malignant bone neoplasm	2	0.6
Malignant testicular neoplasm	2	0.6
Malignant parotid neoplasm	1	0.3
Total	317	100

CNS, central nervous system.

Table 2. Types of magnetic resonance imaging examination performed

Examination	n	%
Cranium	158	50.3
Spine	99	31.2
Abdomen	22	7.0
Pelvis	19	6.0
Appendicular skeleton	14	3.8
Face	4	1.3
Neck	1	0.3
Total	317	100

Table 3. The most common signs and symptoms

Signs and symptoms	n	%
Pain	171	44.0
Cognitive changes	48	12.3
Asthenia and aphasia	33	8.5
Paresis, paralysis, and hemiplegia	32	8.2
Vertigo	25	6.4
Nausea and vomiting	21	5.4
Seizure	19	4.9
Vision and eye changes	16	4.1
Jaundice	7	1.8
Fever	7	1.8
Edema	4	1.0
Constipation	2	0.5
Dysphagia	2	0.5
Hematuria	1	0.2
Total	388	100

MRI findings were positive (i.e., confirming indications) in 211 (66.6%) cases and negative in

106 (33.4%) cases. Among positive results, specific findings were neurological in 111 (52.6%) cases, spinal in 60 (28.4%) cases, abdominal in 17 (8%) cases, pelvis in 12 (5.7%) cases, appendicular in 4 (1.9%) cases, facial in 2 (0.9%) cases, and of the neck in 1 (0.5%) case. Specific findings are included in Table 4.

Table 4. Specific findings in MRI reports

Neurological	n	%
Lesions secondary to the underlying disease or metastasis	89	78.0
Cerebral edema	13	11.4
Ischemic stroke	10	8.7
Parenchymal hemorrhage	1	0.8
Aneurysm	1	0.8
Encephalomalacia	1	0.8
Total	114	100
Spinal	n	%
Secondary bone lesions	45	67.1
Nerve root compression	16	23.8
Pathological vertebral fracture	4	5.9
Vertebral canal infiltration	2	2.9
Total	67	100
Abdominal	n	%
Cholangitis and cholecystolithiasis	8	34.7
Expansive infiltrate formation	4	17.3
Tumor recurrence	4	17.3
Anorectal fistula	2	8.7
Nodules secondary to the underlying disease	2	8.7
Pancreatic disease	2	8.7
Hydronephrosis	1	4.3
Total	23	100

Pelvis	n	%
Secondary bone lesions	11	84.6
Subcutaneous plane edema	1	7.6
Tumor recurrence	1	7.6
Total	13	100
Limbs	n	%
Secondary bone lesions	3	75.0
Osteonecrosis	1	25.0
Total	4	100
Face	n	%
Infiltrative lesions	2	100
Total	2	100
Neck	n	%
tumor recurrence	1	100
Total	1	100

Based on clinical and MRI findings, hospital admission was performed in 236 (74.4%) cases including 20 (6.3%) patients admitted to the intensive care unit. Sixty one (19.2%) patients were discharged, Regarding treatment, 301 (95%) patients received clinical drug, 41 (12.9%) received chemotherapy and/or radiotherapy, 31 (9.8%) patients underwent surgery, 14 (4.4%) patients were placed under observation, and 2 (2.0%) patients underwent biopsy. The evolution of the patients was observed seven days after the MRI exams, 170 (53.6%) patients were discharged from the hospital, 122 (39.6%) patients remained hospitalized, and 19 (6.2%) patients were placed under palliative care.

DISCUSSION

In the present study, we examined the role of MRI in the evaluation of urgent and emergent cases at an oncology referral center. The main indication for MRI examination was the investigation of metastases and complications related to the underlying disease, which demonstrates that this modality was used in daily practice at the center.¹² MRI examination was used

for patients in all age groups, including the pediatric population, which reflects the intrinsic advantages of this imaging modality and greater awareness of the risks associated with radiation exposure.¹³⁻¹⁴

As 66.6% of the MRI examinations reviewed in this study yielded positive results, we consider MRI to be good option for the evaluation of urgent and emergent oncological cases; traditional barriers to emergent MRI are being overcome with simplified imaging protocols and new rapid acquisition sequences.¹⁵ The main positive MRI findings in our sample were neurological, spinal, and abdominal/pelvic. Neurological disorders, most frequently the growth of secondary lesions and metastases, cerebral edema, and ischemic stroke, were detected in 52.6% of cases. The use of MRI for emergent neurological examination, especially in cases of suspected stroke, has increased, but whether MRI can serve as the main imaging modality in this context remains unclear.¹⁶ In one emergency department, full accessibility of MRI at all times resulted in its use to assess stroke and an increase in the proportion of discarded stroke diagnoses.¹⁷

The most frequent spinal findings (28.4% of all findings) were secondary bone lesions, nerve root compression, and pathological vertebral fractures. MRI is the gold standard for the assessment of spinal cord injuries, intervertebral discs, and spinal ligaments and soft tissues; it aids the assessment of injury extent and likely mechanism or cause.¹⁸

Abdominal and pelvic findings represented 8% of all specific findings, the most frequent of which were cholangitis and cholecystolithiasis, expansive infiltrate formation, and tumor recurrence. The utility of MRI for the detection of small foci of infection, necrosis, and pathological fluid collection is well established; this modality has been proven to be superior to other cross-sectional imaging techniques, such as computed tomography and ultrasonography.⁷

Oncological emergencies are the results of acute conditions caused by cancer or its treatment; they require rapid intervention, as they entail imminent risk of death or serious permanent damage.¹⁹ Emergent surgeries have worse prognoses than do elective surgeries, but they should not be avoided or delayed when immediate intervention is needed in patients with cancer, even those with active disease.²⁰ Over a 7-day period, most (53.6%) patients were discharged from the hospital. In previous studies, the use of MRI in

emergency cases did not change patient management, but reduced the admission rate and the length of hospitalization.¹⁻²¹

Magnetic resonance imaging, despite being less used, has been shown to be an alternative to conventional methods, mainly because it is free from the risks of ionizing radiation, does not employ iodinated contrast media, but gadolinium-based agents, which have a lower incidence of adverse reactions and complications.²² In addition, certain subgroups of patients such as pregnant women, children or young individuals who require long-term imaging tests, as in the case of cancer patients, the risks of radiation increase, MRI being a tool increasingly used in these situations.⁹⁻²³

This study has some limitations. First, due to its retrospective nature, it may have been affected by selection bias. In addition, the number of patients included in this single-center study was inadequate for the drawing of definitive conclusions. Larger case series and other studies are needed to support our findings.

CONCLUSION

Magnetic Resonance imaging findings were important to help clinical management of cancer patients, recognizing abnormalities and supporting decisions.

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