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Implementation of Suspected Cord Compression Pathway within the Emergency Department of a Large Tertiary Care Center in Saudi Arabia

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Abstract

Malignant Spinal Cord Compression (MSCC) is a serious emergency, which needs time sensitive management. It is commonly found in patients with advanced cancer with metastasis to the spine. Large tertiary care oncology centers like King Faisal specialist hospital and research center, Riyadh (KFSH&RC) has taken measures to diagnose this complication early and initiate emergency treatment. An evidence-based hospital pathway was launched a year ago by a multidisciplinary team and is currently in place.

We retrospectively audited 24 patients, who had a diagnosis of MSCC, over a period of one year. 43% of these patients presented with back pain and lower limb symptoms. 70% of the MRI scans, showed features of spinal cord compression. 50% of the MSCC patients were diagnosed by the ED physicians. The average length of ED stay for these patients was 632 minutes. Breast cancer was the primary source of MSCC in our patient group. 29% of the patients were treated with a combination of chemo-radiotherapy with only 7% patients needing surgical intervention. Hospital pathway was not triggered for any of our study patients, although all the recommended management steps had been enacted with significant time delays..

Introduction

MSCC remains one of the most serious and frequent neurological complications in cancer patients. The irreversible neurological impairment caused in these patients leads to significant physical and psychological distress. Additionally, increased nursing requirements and decreased independence lead to a notable impact on healthcare expenses. The goal of MSCC treatment is early recognition and diagnosis followed by instituting a quick management plan to improve neurological outcomes [1].

Patients with suspected cord compression may present with subtle or un-differentiated neurological symptoms, which may be clinically misleading. A study by Cook, et al. reviewed 127 patients with clinical suspicion of malignant spinal cord, who had undergone Magnetic Resonance Imaging (MRI) scans of the whole spine. 85 of these patients had evidence of cord compression or spinal cord impingement. Multiple levels of spinal cord compression or impingement were found in 33 of 85 (39%) patients; in 24 of these patients, more than one region (cervical/thoracic/lumbar) of the cord was involved [2].

NICE guideline, UK has recommended step by step diagnostic approach and management of MSCC involving multiple disciplines. There is also a huge emphasis on early recognition and patient awareness. A pathway has been recommended to avoid omission of any of the crucial steps involved in managing this time-sensitive emergency.

G Macdonald, et al. published a study in 2019 to describe the development of such a pathway at Aberdeen Royal Infirmary. The steps involved in building this pathway to implementation were extremely challenging [3].

As the management of MSCC patients involves multiple sequential steps, it is better done by implementing an evidence based pathway. Our study was aimed at auditing our recently developed multi-disciplinary pathway MSCC pathway.

Aim/Objectives

To check implementation of the MSCC pathway from the point of start (Emergency department (ED), clinic or in-hospital bed)

Primary aims:

1. Time of pathway activation, as recorded in the electronic system.
2. Physician's clinical documentation time.
3. Time MRI was requested in the electronic system
4. Time of MRI verified report by a consultant radiologist.
5. Time patient on an in-patient bed.
6. Time of treatment.
7. Disposition.

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Secondary aims:

1. To evaluate the impact of ambulance vs personal transportation on patients' outcome.

2. Identify patterns of patient presentation.

Methods

This was a retrospective study conducted at KFSH&RC. A total of 24 patients were included in the study over a period of one year.

Inclusion Criteria.

All patients aged 14 yrs. and above, who had diagnosis of MSCC.

Exclusion criteria

Patient with incomplete data were excluded

Data collection

Once the study was approved by the Research Advisory Council (RAC), we requested the hospital data warehouse to search relevant patients, based on the ICD 10 codes. The individual patient record was searched individually by the authors, to record all the relevant details in our designed data collection sheet. A literature search was also carried out to find the international practice and use of pathways in other hospitals.

Statistical analysis

The analysis was performed using Stata software version 17. Qualitative data were described as frequency tables and percentages whereas quantitative data were given as means, standard deviation, or median and interquartile ranges (IQR). The association between professional ID categories and number of calls made in one shift was tested using Kruskal-Wallis test. A value of $p < 0.05$ was considered statistically significant in all analysis.

Ethical considerations

The study was approved by Research Advisory Council (RAC#2231246).

It was conducted in accordance with the ethical principles contained in the Declaration of Helsinki (2013), the ICH Harmonized Tripartite Good Clinical Practice Guidelines, the policies and guidelines of the RAC of the KFSH&RC, and the laws of Saudi Arabia.

We did not need patients' consent as there was no contact with the patient for any component of this study. Research subjects were assigned an identification number separate from the Medical Record Number (MRN) to ensure that patients remained anonymous during data analysis. The list of patients' identification number with its respective MRN was kept under lock and key at the emergency department research office for reference when required. The database and all computer files relevant to this research were password protected and known to the investigators and research coordinator only. All files were kept in a secured office within ED and available to the RAC for inspection as per KFSH&RC guidelines.

Results

Table 1 illustrates the baseline characteristics of the included 24 patients. Females comprised 58% of our study population. 54% of the total sample was diagnosed with spinal cord compression. Breast cancer was the primary disease type for 52% of the cases. 71% of the patients arrived at the hospital by wheelchair. ED physicians diagnosed 50% of the study sample, due to patient presentation in ED. Back pain and lower limb motor symptoms made up 43% of the symptoms. 62%

Table1. Baseline characteristics of patients presenting with spinal cord compression

	Categories	N (%)	Total
Age	53.45 ± 16.06		
Gender	Female	14 (58.33%)	24
	Male	10 (41.67%)	
ICD Description	Metastatic cancer	11 (45.83%)	
	Spinal cord compression	13 (54.17%)	
Mode of arrival to ED	Stretcher	5 (23.81%)	21
	Walking	1 (4.76%)	
	Wheelchair	15 (71.43%)	
Diagnosis by EM physician or non EM	Emergency	11(50.00%)	22
	Other	11 (50.00%)	
Type of treatment received	Chemotherapy	6 (30.00%)	20
	Chemotherapy + Radiation	6 (30.00%)	
	Chemotherapy + Surgery	1 (5.00%)	
	Radiation	3 (15.00%)	
	Surgery	2 (10.00%)	
	None	2 (10.00%)	
Clinical symptoms and suspicion	Back pain	7 (30.43%)	23
	LL motor	1 (4.35%)	
	LL pain	1 (4.35%)	
	UL motor	2 (8.70%)	
	Back pain + LL motor	10 (43.48%)	
	LL motor and sensory	1 (4.35%)	
	UL motor + LL motor	1 (4.35%)	
Neurological Status (Physical examination)	LL weakness	13 (61.90%)	21
	UL + LL weakness	2 (9.52%)	
	UL weakness	2 (9.52%)	
	Normal	2 (9.52%)	
	None	2 (9.52%)	
Oncology	Yes	22 (91.67%)	24
	No	2 (8.33%)	
Morphology of vertebral injury	Compression	17 (70.83)	
	Bony lesions	7 (29.17%)	
Pathway Activation	Yes	1 (4.00%)	25
	No	24 (96.00%)	
Consultation with appropriate services	Medicine	15 (62.50%)	24
	Surgery	3 (12.50%)	
	Medicine +Surgery	4 (16.67%)	
	No	2 (8.33%)	
Findings of spinal cord Compression on MRI	Yes	16 (69.57%)	23
	No	7 (30.43%)	
Primary disease type	Breast cancer	12 (52.17%)	23
	Ewing sarcoma	2 (8.70%)	
	Hepatocellular cancer	1 (4.35%)	
	Lung cancer	1 (4.35%)	
	Lymphoma	1 (4.35%)	
	Mesothelioma	1 (4.35%)	
	Multiple myeloma	1 (4.35%)	
	Renal cell cancer	1 (4.35%)	
	Rheumatoid arthritis	1 (4.35%)	
	Thyroid cancer	1 (4.35%)	
	Urothelial cancer	1 (4.35%)	
Neurological Status at Discharge	Affected	10 (45.45%)	22
	Deceased	1 (4.55%)	
	Intact	11 (50.00%)	

ICD: international classification of disease

Table 2. Time differences in spinal cord compression management

Variables	Mean ± SD	Median (IQR)	Total
ED length of stay	631.57 ± 579.9	342.5 (150 –1440)	14
Time seen by ED physician till time to MRI (inminutes)	117.4 ± 104.6	134 (28.3–173)	7
Time to MRI till time of intervention (inminutes)	9753.3 ± 8062	9744 (1696 –17820)	3
Timeof triage till time seen by ED physician (inminutes)	104.5 ± 86.82	77 (30–159)	12
Time seen by EDphysician till time of consultation order placement (inminutes)	124 ± 109.88	128 (1–231)	6
Timeofconsultation till time of consulted service arrival (inminutes)	356.66 ± 502.10	103 (32–935)	3

Numbers were obtained from patients who showed cord compression on their MRI scans.

Table 3. Patients' related characteristics stratified by spinal cord compression status on MRI

Patients' related characteristics	Yes	No	P- value
Gender: -			
- Female - Male	- 9 (56.25%) - 7 (43.75%)	- 4 (57.14 %) - 3 (42.86%)	0.968
Mode of arrival to ED: -			
- Stretcher - Wheelchair	- 3 (23.08%) - 10 (76.92%)	- 2 (28.57%) - 5 (71.43%)	0.543
Cancer types: -			
- Ewing sarcoma - Breast cancer - hepatocellular cancer - lung cancer - lymphoma - mesothelioma - multiple myeloma - renal cell cancer - rheumatoid arthritis - thyroid cancer - urothelial cancer	- 2 (13.33%) - 7 (46.67%) - 0 (0.00%) - 1 (6.67%) - 0 (0.00%) - 1 (6.67%) - 1 (6.67%) - 1 (6.67%) - 1 (6.67%) - 1 (6.67%) - 0 (0.00%)	- 0 (0.00%) - 4 (57.14%) - 1 (14.29%) - 0 (0.00%) - 1 (14.29%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%) - 1 (14.29%)	0.417
Type of treatment the patient is receiving: -			
- Chemotherapy - Radiation - Surgery - Chemotherapy + Radiation - Chemotherapy + Surgery	- 4 (28.57%) - 3 (21.43%) - 2 (14.29 %) - 4 (28.57%) - 1 (7.14%)	- 2 (50.00%) - 0 (0.00%) - 0 (0.00%) - 2 (50.00%) - 0 (0.00%)	0.632
Pathway activation: -			
- Yes - No	- 0 (0.00%) - 16 (100.00%)	- 1 (14.29 %) - 6 (85.71%)	0.122
Neurological Status at Discharge: -			
- Affected - Deceased - Intact	- 10 (62.50%) - 1 (6.25%) - 5 (31.25%)	- 0 (0.00%) - 0 (0.00%) - 5 (100.0%)	0.027*
Diagnosis by ED physician or other: -			
- EM - Other	- 8 (53.33%) - 7 (46.67%)	- 2 (33.33%) - 4 (66.67%)	0.407
Consultation with appropriate services: -			
- Medicine - Surgery - Medicine + Surgery	- 9 (60.00%) - 4 (26.67%) - 2 (13.33 %)	- 6 (85.71%) - 0 (0.00%) - 1 (14.29%)	0.312

*: significant.
Wilcoxon and Chi square tests were used.

Note: **column** percentages were used

of the patients presented with weakness in left lower extremity. MRI revealed 71% patients had MSCC due to vertebral collapse, while the remaining had bony lesions. 55% patients of our study patients had altered neurological status at time of discharge.

The average length of stay was 631minutes. Time intervals between different stages of care, such as time to MRI, time of intervention, and time of consultation varied considerably [Table 2].

Among the 16 patients with proven MSCC on MRI, 56% were females. 77% of them arrived on wheelchair to the hospital. Breast cancer was the primary disease in 47% of our sample patients. It is noteworthy that none of the patients had pathway activation. There was a significant difference between the neurological status at discharge of the patients and the compression status on their MRI (P-value = 0.027**) [Table 3].

88% of patients with compression on MRI had an oncological condition however this difference was not statistically significant (P-value = 0.328). The was no statistically significant difference in clinical symptoms and suspicion of cord compression on MRI (P-value = 0.302).

Among patients with cord compression on MRI, the most common neurological status was LL weakness (64.29%). All patients with MSCC on MRI had vertebral injury, which reached significance (P-value = 0.000**), while 86% of patients without compression had bony lesions. Patients with spinal cord compression on MRI were more likely to have the ICD description of spinal cord compression (75%) compared to metastatic cancer (25%). This difference was highly statistically significant (P-value= 0.007**) [Table 4].

The patients' neurological status at discharge was not significantly impacted by the time it took for them to receive an MRI after being seen by a physician (P-value= 0.1861) [Table 5].

Table 4. Clinical characteristics stratified by spinal cord compression status on MRI

Clinical characteristics	Yes	No	p-value
Oncology: -			
- Yes - No	- 14 (87.50%) - 2 (12.50%)	- 7 (100.00%) - 0 (0.00%)	0.328
Clinical symptoms and suspicion: -			
- Back pain - Back pain + LL motor - LL motor - LL motor and sensory - LL pain - UL motor - UL motor + LL motor	- 2 (12.50%) - 8 (50.00%) - 1 (6.25%) - 1 (6.25%) - 1 (6.25%) - 2 (12.50%) - 1 (6.25%)	- 4 (66.67%) - 2 (33.33%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%)	0.302
Neurological Status (Physical examination): -			
- LL weakness - UL weakness - UL + LL weakness - Normal	- 9 (64.29%) - 2 (14.29%) - 2 (14.29%) - 1 (7.14%)	- 4 (100.00%) - 0 (0.00%) - 0 (0.00%) - 0 (0.00%)	0.577
Morphology of vertebral injury: -			
- Bony lesion - Compression	- 0 (0.00%) - 16 (100.00%)	- 6 (85.71%) - 1 (14.29 %)	0.000**

*: significant, LL: (Lower Limb), UL: (Upper Limb)
Chi square test was used.

Note: **column** percentages were used.

Table 5. Association of the neurological status at discharge with average time seen by ED physician till time to MRI

Neurologicalstatus	N (%)	Median(IQR)	P-value
1-Affected	6 (46.15%)	1 (1-1)	0.1861
2-Deceased	1 (7.69%)	12 (12-12)	
3-Intact	6 (46.15%)	2 (1-3)	
Kruskal- Wallis test was used.			

Discussion

The implementation of multi-disciplinary clinical pathway needs awareness, training and auditing of all stakeholders. None of our patients with proven MSCC, had the pathway trigged, which highlights the importance of involvement and training the end users. The lack of pathway use caused significant delays which impacts on patients' overall management and prognosis.

All our patients had a prior diagnosis of cancer, showed female predominance and high prevalence of breast cancer. A significant proportion (50%) of these patients were clinically diagnosed by ED physicians, demonstrating awareness, knowledge and diagnostic ability.

In 2011, a comprehensive review highlighted how essential it was to approach vertebral metastasis systematically in order to achieve the best possible outcome for MSCC patients. Identifying this potentially life threatening condition quickly and evidence-based management steps can lead to promising results. Providing effective pain relief through medication and focusing on targeted therapy helps minimize patient suffering. Understanding urgency of surgical intervention or advanced radio therapeutic techniques can have a significant impact on specific groups of patients [4]. We noticed evidence based steps incorporated in our devised hospital MSCC pathway. Although the physicians failed to trigger the pathway in the electronic system, they seemed to have diagnosed the patients based on clinical symptomatology. The subsequent management of our study sample was appropriate except time delays, which could have been avoided by following the pathway systematically.

A systematic review done in Ontario Canada describing MSCC patients found the common presenting symptoms involved changes in sensation, dysfunction of the autonomic nervous system, and back pain. However back pain alone does not reliably predict the presence of MSCC. The diagnostic sensitivity of MRI ranged from 0.44 to 0.93, while the specificity was 0.90 to 0.98. Similarly, myelography demonstrated a sensitivity from 0.71 to 0.97 and a specificity ranging from 0.88 to 1.00 [5]. Our study patients' presentations and MRI findings concur with the above study.

A randomized study revealed patients with MSCC, who received high-dose dexamethasone prior to radiotherapy (RT) had higher rates of ambulation compared to those who did not receive corticosteroids before RT (81% vs 63% at 3 months respectively; P = 0.046) [5]. Although our hospital MSCC pathway clearly recommends dexamethasone, we could not find that it consistently prescribed for our study patients. This also reinforces the need of following the pathway, as it contains a check list of mandatory actions, which can be immediately ordered in the system after the pathway is triggered.

Another observational study observed the course of 10 MSCC patients from January to December 2009. The primary cancers observed in these patients were prostate (30%), breast (30%), and lung (20%). The remaining 20% consisted of multiple myeloma and urothelial tumors. Bone metastasis was diagnosed in 90% of these patients with pain as a primary symptom (90%), while weakness in the limbs was experienced by 70%. Sensory changes, however, were only reported by a minority of patients (10%) [6].

The NICE guidelines comprehensively addresses the overall management of these patients, through a pathway based approach. Back pain, autonomic dysfunction and lower limb sensory/motor symptoms are mentioned as common presenting symptoms of MSCC. Various diagnostic techniques such as MRI and CT (when MRI is not suitable) are recommended diagnostic modalities. Furthermore, administration of high-dose dexamethasone before RT is highly recommended as it may improve ambulation rates. There is currently no concrete evidence with regards to surgical intervention for progressive symptoms & it also remains uncertain, whether patients with spinal instability should undergo surgical treatment [7].

Conclusion

Centers dealing with MSCC should implement pathway based management with appropriate training and awareness of all stakeholders. Compliance with the pathways should be regularly audited.

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