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ARTICLE

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Survival, discharge destination, and referral for rehabilitation after metastatic spinal cord compression surgery

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STUDY DESIGN: A retrospective review of medical records.
OBJECTIVE: The objective of this study was to examine probability of survival after 90- and 180-days after surgery, to document the rehabilitation needs, patients discharge destination, and whether discharge destination, re-admission, and probability of survival among patients with metastatic spinal cord compression (MSCC) were associated with potential risk factors.
SETTING: Copenhagen University Hospital, Rigshospitalet that serves a population of 2.8 million people from the Eastern part of Denmark, Faroe Islands, and Greenland.
METHODS: Adult (≥18 years) patients with MSCC undergoing surgery in 2017–2018 were included. Descriptive statistics were used to investigate the probability of survival after 90- and 180-days, rehabilitation needs documented in the patient's medical record, and discharge destination. Univariate logistic regression analyses were used to examine the associations between a priory defined potential risk factors for mortality and readmission.
RESULTS: Seventy-four medical records were included in final analysis. The probability of survival after 90- and 180-days post-surgery were 78% and 57%, respectively. Higher age was the only defined variable that was significantly associated with higher mortality. Ninety-three percent of the patient's medical records described rehabilitation potential, but only 44.6% of the patients were discharged with a rehabilitation plan. Seventy-three percent of the patients were discharged to their home. None had a specialized rehabilitation plan.
CONCLUSION: Almost all patients diagnosed with MSCC have a rehabilitation potential described in their medical records. However, only half of these patients are discharged with a rehabilitation plan indicating an unmet potential for rehabilitation.

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INTRODUCTION

Knowledge regarding survival after nontraumatic spinal cord dysfunction is limited [1, 2]. The etiology and all-cause mortality of non-traumatic spinal cord dysfunction is heterogeneous, but treatment of patients diagnosed with cancer is generally associated with substantial healthcare costs [1, 3–5]. Patients with metastatic spinal cord compression (MSCC) constitute a subset of patients diagnosed with non-traumatic spinal cord dysfunction. The condition is a result of the progression of malignant disease and neoplastic metastasis to the spine or epidural space, causing displacement and compression of the spinal cord [6, 7].

Primary bone cancers are rare as these accounts for only 0.2% of all new cancer diagnoses [8], however, bone metastases are common in patients diagnosed with primary cancer [9]. Primary tumors that most often lead to bone metastasis are in the order of incidence: prostate, breast, kidney, and lung [10]. Bone metastasis are not always symptomatic or are for other reasons not always diagnosed or treated, but metastatic spread to the spine often occurs. Hence, by autopsy it has been shown that up to progression of cancer up to 70% of patients with advanced stage breast or prostate cancer, and 15–30% of patients with lung, colon, bladder, or kidney cancer eventually develop bone metastasis [11]. Patients with metastatic cancer show increased risk of pain progression, increased use of strong opioids, decreased sleep quality, decreased ability to walk, markedly reduced health-related quality of life, decreased workability, and social relationships [12–15]. It has been estimated that 2.5% of patients who die from cancer will have experienced at least one episode of MSCC but only 20% will be considered eligible for operation [16, 17]. For those eligible for operation, the operation has shown to improve health related quality of life [17]. However, in clinical practice, the assessment of eligibility for operation is typically based on cancer stage, primary cancer location, expected survival and whether the expected outcome of operation outweighs the risks to the patient undergoing the treatment [18–20]. Untreated metastatic spinal cord compression will result in loss of gait function and bladder or bowel problems, and therefore the diagnosis is considered an indication for urgent treatment even in a palliative care setting [21, 22]. When a patient is surgically treated for MSCC the patient is expected to survive for 3 months or more. It has been reported that 92% of the patients with a high symptomatic burden due to metastatic bone diseases were interested in, and felt able to participate in an exercise-based intervention [23]. Furthermore,

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rehabilitation has been found effective for improving physical performance and health-related quality of life even in patients with advanced stage of cancer [24].

One treatment goal for patients with MSCC is that all should have a treatment strategy that include an assessment of ongoing care and rehabilitation needs [21]. In addition, the National Institute for Health and Care Excellence (NICE) clinical guideline for patients with MSCC states that admission to a specialist rehabilitation unit should be offered, for those patients with MSCC who are most likely to benefit, for example, those with a good prognosis, high activity tolerance, and strong rehabilitation potential [25].

Therefore, the aim of this retrospective study was to examine 1) probability of survival after 90- and 180-days post-surgery for patients with MSCC, 2) the percentage of patients who has an assessment of rehabilitation needs in the patient's medical record; 3) the proportion of patients discharged to own homes, specialized rehabilitation units, other hospitals, and hospice; 4) if age, gender, days of hospitalization, bone metastasis site, civil status, and the number of re-operations predict where patients are discharged to; and 5) whether age, gender, days of hospitalization, bone metastasis site, civil status, and the number of re-operations predict mortality and hospital re-admissions.

METHODS

Design

This is an observational study using data from a retrospective review of electronical medical records. To secure the relevance of the research questions these were discussed with the representatives from the consumer organization for people with spinal cord injuries in Denmark.

Study population

The Danish Health Data Authority electronic database were used to identify patients who were registered with activity for spinal cord compression (ICD10 DG952A). The list of unique central person register numbers (CPR-nos.) was limited to include patients from the Copenhagen University Hospital, Rigshospitalet that serves a population of 2.8 million people from the Eastern part of Denmark, Faroe Islands and Greenland. Patients were eligible for inclusion if they were adult (≥18 years), had a diagnosis of a primary cancer with metastasis to the spine, and had received surgery for spinal cord compression at the Department of Orthopaedic Surgery, Rigshospitalet during 2017 or 2018.

Procedure

The a priory defined standardized data abstraction form that contained all variables of interest was used for data extraction and data abstractors were trained carefully before conduction of the medical record review. The two data abstractors performed a pilot test of the first 10 medical records to test the accessibility of the data extraction form. After completion of the pilot test, the data extraction form was revised, and the data extraction started over. All identified patients medical records were assessed and if eligible the following non-comprehensive list of variables were extracted from the electronic medical records; age at the time of hospital admission, gender, civil status, where patients were discharged to, formal education, performance status, type of cancer, primary tumor site, cancer stage, bone metastasis site, medical diagnosed comorbidities, gait disturbance, balance problems, muscles weakness, care for lymphedema problems with activities of daily living, fatigue, range of motion, persistent pain, bladder or bowel problems explicit described in the patients' medical record after surgery, content of a rehabilitation plan, and patients preferences for rehabilitation, days of hospitalization, number of re-operations, hospital re-admissions, predicted life-expectancy, and potentially a time of death. Data were extracted from the medical record during November 2019.

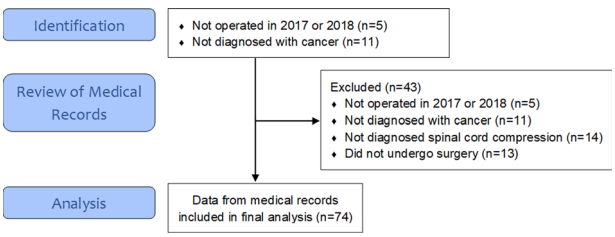

Fig. 1 Study flow diagram. One-hundred-and-seventeen medical records were identified through the medical database at Copenhagen University Hospital, Rigshospitalet with (ICD 10 DG952A, spinal cord compression) in 2017 or 2018.

Statistical analysis

Calculation of inter-rater reliability for the agreement of inclusion of patients during the pilot test were conducted using Cohen's kappa (κ), and interpreted according to the definitions of Landis and Koch were >0.81 represents excellent, 0.61–0.80 substantial, 0.41–0.60 moderate, 0.21–0.40 fair, <0.20 slight levels of agreement [26]. A minimum acceptable κ coefficient for retrospective medical record reviews have been suggested as 0.6 representing a substantial level of agreement [27]. For descriptive statistics, patient characteristics are presented as means with standard deviation for approximately normal distributed continuous variables or as median and range for non-normally distributed continuous variables. Categorical and numerical variables are summarized by absolute frequencies and percentages. Patients can be discharged with two types of rehabilitation plans. A regular rehabilitation plan (once a patient is discharged from hospital, the responsibility for rehabilitation falls to the municipality), and a specialized rehabilitation plan covering complex, extensive, rare and/or severe functional impairments of significant importance for several areas of life (the responsibility for rehabilitation falls to the hospitals). Patients who are discharged with a regular rehabilitation plan can be discharged to their own home, rehabilitation units within the municipality (general rehabilitation units), spinal cord specific rehabilitation units, or a hospice.

The probability of survival after 90- and 180 days, the extent to which an assessment of rehabilitation needs was documented in the patient's medical record and the proportion of patients discharged to other hospitals, hospice, rehabilitation units within the municipality, specialized rehabilitation units, and their own home, respectively, are presented as frequencies and percentages.

Patients were categorized as having a rehabilitation potential if at least one of the following variables were explicitly described in the patients' medical record after surgery: gait disturbance, balance problems, muscles weakness, care for lymphedema, problems with activities of daily living, fatigue, range of motion, persistent pain, bladder or bowel problems. Univariate multinomial logistic regression analysis was used to investigate the relationship between a priory defined independent variables (1) age, (2) gender, (3) days of hospitalization, (4) civil status, and (5) bone metastasis site, and the dependent variables (1) number of re-operations and (2) discharge destination. Univariate logistic regression analyses were used to examine associations between potential risk factors (age, gender, civil status, days of hospitalization, number of re-operations, and bone metastasis site) for mortality and readmissions. The degrees of freedom of the Chi-Square distribution, the Likelihood Ratio Chi-Square test (Chi2) and the p value for the Chi2 test, and relative-risk ratios with a 95% Confidence Intervals and the p values are furthermore reported. An alpha level below 0.05 was considered statistically significant and all analyses were conducted in STATA (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.)

Ethics

Approval for conduction of this study was granted by the Danish Patient Safety Authority and The Danish Data Protection Agency approved the handling of data (rh.01.02.04.19). Furthermore, the study complies with ethical principles for medical research as described in the Helsinki Declaration II.

RESULTS

A total of 117 patients with MSCC was identified from the Danish Health Data Authority electronic database. Despite a perfect (Cohen's kappa 1.0) inter-rater reliability between the two data abstractors, the pilot test of the first ten possible patients resulted in minor changes in the data extraction form and some further elaborated definitions of variables.

All medical records were then reviewed, and a total of 74 patients were eligible for inclusion (Fig. 1), and hence, data from these medical records were extracted and analyzed.

Table 1. Patients characteristics ($n = 74$).

Age, median (IQR)	67 (58–73)
Males, *n* (%)	40 (54.1)
Civil status, *n* (%)	
Living alone	18 (24.3)
Living together with someone	52 (70.3)
Unknown	4 (5.4)
Occupational status ($n = 66$), *n* (%)	
Working fulltime	18 (27.3)
Working part-time	1 (1.5)
Studying	2 (1.5)
Early retirement	3 (4.5)
Retired	43 (65.2)
Performance status (WHO), *n* (%)[a]	
Classification 1	2 (2.7)
Classification 2	36 (48.7)
Classification 3	28 (37.8)
Classification 4	8 (10.8)
Primary cancer diagnoses, *n* (%)	
Lung	18 (24.3)
Breast	10 (13.5)
Kidney	8 (10.8)
Gastrointestinal	7 (9.5)
Prostate	7 (9.5)
Bone marrow	6 (8.1)
Lymphatic	3 (4.1)
Lever	3 (4.1)
Pancreas	2 (2.7)
Other[b]	6 (8.1)
Unknown	4 (5.4)
Medical diagnosed comorbidity, *n* (%)[c]	61 (82.4)
Primary spinal metastatic tumor location. *n* (%)	
Cervical	4 (5.4)
Thoracic	41 (55.4)
Lumbar	29 (39.2)

[a]WHO performance status: 1 = restricted in strenuous activity but ambulatory and able to carry out light work, 2 = ambulatory and capable of all self-care but unable to carry out any work activities; 3 = symptomatic and in a chair or in bed for >50% of the day but not bedridden, 4 = completely disabled; cannot carry out any self-care; totally confined to bed or chair.
[b]This category contains one of the following; malignant melanoma, tonsil, bile duct, muscle, thyroid, and uterus cancer.
[c]Medical diagnosed comorbidity = more than one disorder in the same person which have been diagnosed by a physician (e.g., Diabetes mellitus type 2 or chronic obstructive lung disease).

Table 2. Explicit described symptoms in the patients' medical record before surgery for metastatic spinal cord compression ($n = 74$).

Pain	57 (77.0%)
Gait disturbance	19 (25.7%)
Bladder or bowel problems	12 (16.2%)
Subjective weakness	8 (10.8%)
Limited range of motion	8 (10.8%)
Fatigue	6 (8.1%)
Problems with activities of daily living	5 (6.8%)
Dizziness	4 (5.4%)
General neurological symptoms	3 (4.0%)
Decreased muscle strength	3 (4.0%)
Sleep disorder	1 (1.3%)
Dysphagia	1 (1.3%)
Affected respiration	1 (1.3%)
Explicit described rehabilitation potentials in the patients' medical record after surgery for metastatic spinal cord compression ($n = 74$)	
Gait	30 (40.5%)
Balance	28 (37.8%)
Strengthening of muscles	21 (28.4%)
Activities of daily living	13 (17.6 %)
Endurance	10 (13.5%)
Range of motion	2 (2.7%)
Persistent pain	1 (1.3 %)
At least one of the above rehabilitation potentials described.	69 (93.2%)

Symptoms are reported as *n* (%).

The 74 included patients were primarily men (54.1%) who were living together with someone (70.3%) and had a median age of 67 years (IQR, 58–73 years). The three most frequent primary cancers were lung (24%), breast (14%), and kidney (11%). A full list of patient characteristics is presented in Table 1.

The probability of survival 90 days post-surgery was 78.4% and the probability of survival 180 days post-surgery was 56.8%.

Table 2 presents explicitly described symptoms in the patients' medical records before metastatic spinal cord compression surgery, and Table 2 presents specific indicators for and the total rehabilitation potential as described in the patients' medical records after metastatic spinal cord compression surgery. Information on orthosis and prosthetics, care for lymphedema, management of bladder or bowel problems, swallowing therapy, respiratory physical therapy seek obtained prior to operation from the medical records, but this information was not explicit described in any of the medical records.

In 93.2% of the patients' medical records a rehabilitation potential was described. Of those who had a rehabilitation potential described in the medical record only 44.6% of the patients were discharged with a rehabilitation plan. Among 6.8% of patients were a rehabilitation potential not described, and none were discharged with a rehabilitation plan. None of the rehabilitation plans were specialized rehabilitation plans. Among patients who had a rehabilitation potential and who received a rehabilitation plan 32 % survived less than 90 days, 32% survived between 90 and 180 days and 37% survived more than 180 days. Among patients who did not received a rehabilitation plan 37% survived less than 90 days, 30% survived between 90 and 180 days and 33% survived more than 180 days.

Explicit described rehabilitation potential factor after surgery in the patients' medical record can be found in Table 2. Patients were discharged to their home (73.0%), rehabilitation units within the municipality (9.4%), to other hospitals for further medical treatment (6.8%), hospice (2.7%), and in four patients (5.4%) it was unclear where the patients were discharged to.

Table 3 presents the relationship between defined independent variables age, gender, days of hospitalization, civil status and bone metastasis site and the number of re-operations and where patients were discharged to. Age, number of re-operations, and bone metastasis were not associated with discharge destination.

Table 3. The relationship between a priory defined risk factors and where patients were discharged to.

Variable	Coefficient	*p* value	Relative-risk ratio	95%CI
Age				
Model (LR chi2 = 3.20, *p* = 0.36)				
Own home	(Ref)	(Ref)		
Rehabilitation units within the municipality	0.06	0.17	1.07	0.97: 1.17
Other hospitals	−0.03	0.40	0.97	0.90: 1.04
Hospice	−0.01	0.90	0.99	0.87: 1.12
Gender (ref male)				
Model (LR chi2 = 8.33, *p* = 0.03)				
Own home	(Ref)	(Ref)		
Rehabilitation units within the municipality	−2.15	0.04	8.61	1.01: 73.70
Other hospitals	−0.48	0.62	1.61	0.25: 10.45
Hospice	−15.83	0.99	[a]	[a]
Civil status (ref living alone)				
Model (LR chi2 = 12.73, *p* = 0.01)				
Own home	(Ref)	(Ref)		
Rehabilitation units within the municipality	−1.93	0.01	6.87	1.51: 31.28
Other hospitals	−1.30	0.19	3.67	0.53: 25.54
Hospice	−17.15	0.99	[a]	[a]
Hospital admission days				
Model (LR chi2 = 11.02, *p* = 0.01)				
Own home	(Ref)	(Ref)		
Rehabilitation units within the municipality	0.05	0.04	1.05	1.01: 1.11
Other hospitals	−0.12	0.20	0.89	0.75: 1.06
Hospice	0.05	0.03	1.04	0.98: 1.12
Number of re−operations				
Model (LR chi2 = 0.96, *p* = 0.81)				
Own home	(Ref)	(Ref)		
Rehabilitation units within the municipality	0.00	1.00	1.00	0.48: 2.07
Other hospitals	0.24	0.40	1.27	0.73: 2.21
Hospice	0.29	0.42	1.33	0.66: 2.71
Bone metastasis site				
Model (LR chi2 = 6.21, *p* = 0.10)				
Own home	(Ref)	(Ref)		
Rehabilitation units within the municipality	−1.34	0.05	0.26	0.06: 1.00
Other hospitals	−1.34	0.12	0.26	0.05: 1.43
Hospice	0.25	0.85	1.69	0.09: 17.21

Hospital admission days, Number of reoperations and Bone metastasis site are interpreted as more days events metastasis sites.
LR chi2 The likelihood ratio (LR) chi-square test.
[a]Insufficient data.

However, more women than men were discharged to rehabilitation units within the municipality, and more patients living alone were discharged to rehabilitation units within the municipality. More hospital admission days was associated with higher relative-risk ratio for being discharged to rehabilitation units within the municipality relatively to being discharged to own home.

A higher age was the only defined variable that was significantly associated with higher mortality (OR = 1.07, 95%CI [1.01: 1.13], *p* = 0.01), Table 3. None of the other selected risk factors were statistically significant associated with readmission, see Table 4.

DISCUSSION

This study shows that the probability of survival after 90- and 180-days post-surgery were 78% and 57%, respectively. Ninety-three percent of the patient's medical records described rehabilitation potential, but only 44.6% of these patients were discharged with a rehabilitation plan. Seventy three percent of the patients were discharged to their home. The probability of survival in combination with described rehabilitation needs indicate an unmet potential for rehabilitation. The probability of survival 90- and 180-days post-surgery is in line with findings from comparable previous studies where the median survival time of patients diagnosed with lung cancer and bone metastasis was 5.8 months [28]. According to The Danish Health legislation and the NICE guideline, patients are entitled to a rehabilitation plan if a medically justified need for rehabilitation is identified upon hospital discharge [25, 29]. Even though MSCC is considered an indication for urgent treatment [18, 19], a judgment for operation is based on expected survival and whether the expected outcome

Table 4. The relationship between a priory defined risk factors and mortality and re-admission to hospital.

Variable	Mortality		Readmission	
	LR Chi2	*P* value	LR Chi2	*P* value
Age	7.65	0.01	2.36	0.12
Gender	0.06	0.81	0.13	0.71
Civil status	0.68	0.41	3.19	0.07
Days of hospitalization	2.21	0.11	0.03	0.86
Number of re-operations	2.98	0.08	1.60	0.21
Bone metastasis site	2.17	0.14	0.62	0.43

Likelihood Ratio (LR) Chi-Square test (Chi2) and the *p* value for the Chi^2 test.

of operation outweighs the risks to the patient undergoing the treatment [18–20]. Combined with the finding that 93.2% of patients were identified to have a described rehabilitation potential, it seems disturbing that less than half of the patients were discharged with a rehabilitation plan. Increasing age was, significantly associated with higher mortality OR=1.07, 95%CI [1.01:1.13]. This is in line with former findings in non-traumatic spinal cord injury patients [2, 5]. However, none of the patient characteristics were statistically significant risk factors for readmission, which may be explained by the limited sample size of the present study.

Our results have some clinical implications. Firstly, considerations of rehabilitation potential are performed and documented in the patients' journal, however, less than half of the patients with a rehabilitation potential were discharged with a rehabilitation plan, thus it seems that current discharge routines should be critically analyzed. Furthermore, our results suggest that there seems to be no pattern toward those patients who receive a rehabilitation plan also are the patients with the highest probability of survival after 90- and 180-days post-surgery. Indirectly, our results therefore suggest that it is difficult upon hospital discharge to identify those patients in need of rehabilitation potential. Combined with the fact that no patients were referred to specialist rehabilitation, it seems challenging to adhere to the NICE guideline that recommends admission to a specialist rehabilitation unit to those patients who are most likely to benefit and those with a good prognosis [25]. Future studies should focus on identification of the patients most relevant for rehabilitation in general as well as specialist rehabilitation.

Strengths and limitations

The present study had several limitations. Firstly, this study was performed at a single center, and therefore organization and procedures and could potentially influence the results, wherefore, generalization of the results should be done with caution. Furthermore, as this is a single center study the included sample reflects this highly specialized hospitals flow of patients. Hence, proportionally the underlying cancer diagnoses might be slightly screwed. On the other hand, the hospital cover nearly half of the Danish population and therefore our results are, with reservations for a slightly skewed sample, considered representative in general. Secondly, inaccuracies or missing reporting in the electronic patient record system cannot be ruled out, which is however a general problem with data obtained using retrospective study designs and is not considered to be explicitly over- or under-represented in this study. However, as the date of death is linked to a national registry via the unique CPR-no., the accuracy of these data can be considered precise and not biased. Due to the retrospective design of the study, the specific explicit described symptom indicators for rehabilitation are expected to be related to some degree of reporting bias. From a clinical perspective, these patients typically present a cluster of symptoms and/or rehabilitation potential, which can be difficult and time consuming to document in the patient's medical record in the daily clinical practice. Therefore, for example, the specific indicators for rehabilitation potential could be underestimated. However, due to the methodology used for classifying patients as having a rehabilitation potential if only one area were explicitly described we are relatively confident that this reflects the proportion of patients with rehabilitation potential. Even though we before conduction of the present study developed a study protocol including a list of variables of interest, a few methodological adjustments were made while conducting the study. It is believed that this resulted in a clearer definition of the outcomes of interest and a more stringent data extraction template. Another methodological adjustment was made as the number of eligible patients was less than expected and therefore it was decided to conduct univariate regression analysis instead of the protocolized multivariate regression analysis.

CONCLUSION

This study adds new knowledge to the limited body of evidence regarding patients operated for MSCC and rehabilitation. To our knowledge, this is the first study to investigate the association between rehabilitation potential and patient characteristics in a MSCC population. Almost all patients diagnosed with MSCC have a rehabilitation potential described in their medical records. However, only half of these patients are discharged with a rehabilitation plan indicating an unmet potential for rehabilitation, and there was no pattern towards those patients who received a rehabilitation plan also were the patients with the highest probability of survival after 90- and 180-days post-surgery. Finally, none of the patients was discharged with a specialized rehabilitation plan.

DATA AVAILABILITY

All data requests should be submitted to the corresponding author for consideration. Access to anonymised data may be granted following review.

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AUTHOR CONTRIBUTIONS

All authors (JC, FBS, SSM and KlC) contributed to the design of the study (and the writing of the study protocol), and implementation of the research, and to the writing of the manuscript. JC conducted all analysis.

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ETHICS STATEMENT

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

COMPETING INTERESTS

The authors report no conflicts of interest. No external funding was obtained for this study. The first authors salary was split equally between Department of Occupational Therapy and Physiotherapy, Copenhagen University Hospital, Rigshospitalet, and REHPA—The Danish Knowledge Centre on Rehabilitation and Palliative Care, University of Southern Denmark.

ADDITIONAL INFORMATION

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