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Original Article

Clinical characteristics of patients with malignancies combined with acute kidney injury

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Abstract: Objective: To analyze clinical characteristics and prognostic factors of patients with malignancies combined with acute kidney injury (AKI), providing a basis for clinical AKI prevention and prognosis improvement. Method: Hospitalized patients in the Central Hospital of Nephrology from January 2008 to December 2013 were screened by electronic medical record system; Statistical analysis formalignant tumor patients associated with AKI was conducted. The clinical features of these patients in 6 years were analyzed and compared, and Logistic regression analysis was used to analyze the risk factors of hospitalized mortality in patients with and malignant tumor and AKI. Results: There were 340 cases of malignancies associated with AKI patients, accounting for 30.0% (340/1133) of AKI patients in the same period. In malignancy patients, hematological malignancies accounted for 12.9% (44/340); non-metastatic solid tumor accounted for 54.7% (186/340); metastatic solid tumor accounted for 32.4% (110/340). In factors leading to AKI, post-renal obstruction [60% (204/340)], nephrotoxic drugs or contrast agents [27.9% (95/340)] and hypovolemia [41/340 (12.1%)] were common in patients with malignant tumors. There was no significant difference in the cause of AKI between early 3 years and later 3 years (P>0.05). Hospital mortality in patients with malignancies associated with AKI was [22.9% (78/340)], with an annually declining trend. Multivariate Logistic regression showed that: multiple etiologies, multiple organ failure, metastatic solid tumor, sepsis, and continuous renal replacement therapy were independent risk factors for hospital mortality. Conclusion: AKI is a common complication in patients with malignant tumors, with post-renal obstruction as the most common factors. Hospital mortality in malignant tumor patients associated with AKI was higher, and the prevention of AKI is crucial in clinical.

Keywords: Acute kidney injury, tumor, prognosis, risk factor

Introduction

With the aging of society, the incidence of cancer is increasing year by year; the results of the 2008 Cancer Registry showed that incidence rate of malignant tumors as well as neuroepithelial tumours was 299.12/100,000, which is still expected to consistently increase [1, 2]. With the application of anticancer drugs, the promotion of radiation therapy promotion, as well as the renal infiltration of tumor itself and its effects on immune inflammatory response, AKI has become a common complication in patients with malignant tumors [3, 4]. Overseas studies show that the most common histological type of solid tumor-associated glomerular damage is membranous nephropathy, which can induce theimmune responses of tumor antigens or podocyte antigens, leading to the formation of circulating or situ immune complexes and kidney injury [5]. Although in the past few years, AKI survival has been improved, but tumor patients complicated with AKI still have a high mortality [5]. In this paper, the clinical features of malignancy patients associated with acute kidney injury were analyzed.

Subjects and methods

Subjects

All the patients were hospitalized from January 2008 to Dec. 2013 in our hospital and met the following conditions: (1) KDIGO diagnostic

Table 1. The characteristics of participants with malignancies combined with acute kidney injury

Indices	Death (n=67)	Survival (n=273)	*P* value
Age (Years)	62.7±12.0	61.6±12.1	0.132
Creatinine (ummol/L)	867.2±132.0	874.2±133.1	0.098
History of CKD [n, %]	16 (23.9)	81 (29.7)	0.114
Oliguria [n, %]	56 (83.6)	205 (75.1)	0.241
Cause of AKI			
Postrenal obstruction [n, %]	45 (67.2)	79 (58.2)	0.108
Nephrotoxic drugs or contrast agents [n, %]	30 (44.7)	65 (23.8)	0.001
Hypovolemia [n, %]	18 (26.9)	23 (8.4)	0.002
Multiple organ failure [n, %]	35 (52.2)	21 (7.7)	0.001

Table 2. Types of malignancies in the participants

Type of cancer	Prevalence (n, %)		
	Total (n=340)	2008-2010 (n=201)	2011-2013 (n=139)
Hematological malignancies	44 (12.9)	31 (15.4)	13 (9.4)
Non-metastatic solid tumor	186 (54.7)	107 (53.2)	79 (56.8)
Metastatic solid tumor	110 (32.4)	68 (33.8)	42 (30.2)

criteria for AKI [6]. All the malignancy were confirmed by biopsy; (2) the age is older than 18 years; (3) exclusion patients with end-stage renal disease who need regular hemodialysis and insufficient clinical data.

Data collection

Gather clinical information from hospital information retrieving system and record including name, hospital number, age, sex, length of stay, etiology, comorbidities, clinical test results and pathological findings, treatment, prognosis and other relevant information and then establish the database.

Definition

(1) AKI: within 48 h Scr value ≥150% baseline value, or Scr increased more than 0.3 mg/dl, or urine output decreased (<0.5 $ml \cdot Kg^{-1} \cdot h^{-1}$) more than 6 h. According urine output and creatinine values they were divided into I, 2, 3 period. (2) malignancy was confirmed by biopsy, and was divided into three groups according to sources and tumor metastasis: hematological malignancies, solid tumors without metastasis and solid tumors with metastases. Hematological malignancies included leukemia, lymphoma and multiple myeloma. Solid tumors included malignancy occurred in craniocerebral, urinary, respiratory, digestive, gynecological and endocrine systems. (3) AKI etiology included hypovolemia, intake of nephrotoxic drugs or contrast agent, tumors of the kidney invasion, tumor lysis syndrome, and other aspects of renal obstruction. Two or more than two factors caused AKI was called multi-cause induced AKI. (4) AKI incidence = case numbers of malignant tumors combined with AKI/case numbers of malignant tumors at the same period; Prevalence rate = case numbers of malignant tumors combined with AKI/number of inpatient at the same period; Hospital mortality = cases numbers of mortality in malignancies patients with AKI in hospital/case numbers of malignant tumors combined with AKI at the same period. (5) blood purification treatment included ordinary hemodialysis and continuous renal replacement therapy. In this study the patients failed to do blood purification treatment through other method. (6) The outcome: complete remission was defined as creatinine levels decreased to normal creatinine or before AKI occurred level after treatment; partial remission was defined as creatinine value was lower than the maximum, but not back to the foundation of the state of renal function, and isolated from the renal replacement therapy after treatment; no relieve was defined as creatinine levels showed no significant change after treatment compared with hospital admission or not isolated from renal replacement therapy.

Statistical analysis

Statistical software SPSS 19.0 was used for statistical analysis. Quantitative data with normal distribution were expressed with Mean

Table 3. Univariate logistic regression analysis of the prognosis of patients with malignant tumors associated with AKI (The death was set as dependent variable)

Variables	OR (95% CI)	*P* values
Age	1.52 (0.87-4.45)	0.432
Gender	1.23 (0.91-3.13)	0.132
History of CKD	1.07 (0.56-3.11)	0.474
Oliguria	3.09 (0.84-6.35)	0.341
Multiple organ failure	10.34 (5.80-29.09)	0.012
Multiple etiologies-caused AKI	4.65 (1.67-8.08)	0.001
Metastatic solid tumors	3.59 (1.77-7.96)	0.032
Sepsis	2.09 (1.34-5.88)	0.043
Continuous renal replacement therapy	4.06 (1.97-8.77)	0.013
Mechanical ventilation	5.45 (2.07-12.73)	0.002

Table 4. Multivariate logistic regression analysis of the prognosis of patients with malignant tumors associated with AKI (The death was set as dependent variable)

Variables	OR (95% CI)	*P* values
Multiple organ failure	8.13 (4.22-18.07)	0.002
Multiple etiologies-caused AKI	6.23 (3.13-20.45)	0.021
Metastatic solid tumors	3.87 (1.65-6.09)	0.012
Sepsis	2.76 (1.35-6.13)	0.023
Continuous renal replacement therapy	3.13 (1.86-7.13)	0.018

± SD. Qualitative data were expressed with rate. t-test or chi-square test was used for comparison between the two groups. Prognostic risk factor was analyzed by using multivariate logistic regression. $P<0.05$ was considered with statistical significance.

Results

General information

There was a total of 340 cases with malignancy combined with AKI, accounting for 30.0% AKI patients at the same period. As shown in **Table 1**, there was no significant difference in the average age, creatinine, history of CKD, Oliguriabetween death and survival group. However, In factors leading to AKI, nephrotoxic drugs or contrast agents and hypovolemia were common in patients with death but not in survival group.

As shown in **Table 2**, in malignancy patients, hematological malignancies accounted for 12.9% (44/340); non-metastatic solid tumor accounted for 54.7% (186/340); metastatic solid tumor accounted for 32.4% (110/340).

The univariatelogistic regression analysis of the prognosis of patients with malignant tumors associated with AKI showed that risk factors of hospital mortality included multiple etiologies-caused AKI, multiple organ failure, metastatic solid tumors, sepsis, continuous renal replacement therapy and mechanical ventilation (**Table 3**).

The above variables were enrolled in Logistic regression model and the results suggested that multiple etiologies-induced AKI, multiple organ failure, metastatic solid tumors, sepsis, and continuous renal replacement therapy were independent risk factors for hospital mortality in patients with malignancies associated with AKI, shown in **Table 4**.

Discussion

In this study, we found AKI incidence in patients with malignant tumors tended to decrease, related with increased awareness of clinicians about the prevention of AKI of patients, especially cancer patients.

In factors leading to AKI, post-renal obstruction was the most common factor in patients with malignant tumor include astrocytoma and glioblastoma etc; The obstruction due to tumor followed by the application of nephrotoxic drugs or contrast agents, consistent with domestic research. Between 2008-2010 and 2011-2013, there were no significant differences in the etiologyspectrum of AKI for cancer patients. The larger proportion of post-renal obstruction may be related to that digestive and urologic cancer were common, which often leads to urinary tract obstruction. In addition, metastatic solid tumors accounted for a larger proportion; extensive peritoneal metastasis is often combined with bilateral ureteral obstruction, resulting in increased occurrence rate of AKI. In the treatment of cancer, application of chemother-

apy drugs and radiotherapy promotion also caused some damage to the kidneys. Li et al [7] conducted a prospective study in 100 tumor patients with Gamma treatment and found that the incidence rate of AKI was 25%; most AKI was related to the contrast agents. Thus, for cancer patients, we should try to lift the oppression of tumors on the urinary system, assess renal function and the risk of AKI in treatment, select drugs with small nephrotoxicity, ensure a full hydration before and after contrast media, minimize the amount of contrast agents, and ensure the dosing interval, in order to minimize the occurrence of AKI.

Hospital mortality in patients with malignancies complicated with AKI was as high as 25%, with an annually decreasing trend. Its yearly reduction may be related with the improved clinical diagnosis and treatment, the careful use of nephrotoxic drugs, improved health insurance policy and enthusiasm of families. Multivariate Logistic regression analysis showed that multiple organ failure, metastatic solid tumors, multiple etiologies-caused AKI were independent risk factors of hospital mortality for patients with malignant cancer complicated with AKI. Previous studies have shown that multiple organ failure was related with the high mortality rate of AKI [7]; for each additional extra-renal organ failure, the risk of death in patients with AKI will increase 1.376 times. Meanwhile, metastatic solid tumors was a risk factor for the mortality in malignant tumor include neuroepithelial tumours patients with AKI; the high mortality was associated with cancer-related multiple organ damage and poor foundational conditions. Most studies have been reported that the severity of AKI was related with its prognosis; increase in serum creatinine may be accompanied by elevated AKI mortality. The present study found no correlation between AKI stage 1 and mortality; probably because most of the research objects were in AKI 3 stage, resulting in result deviation due to the large proportion.

Previous reports about the effect of chronic kidney disease history on mortality in patients with AKI varied; this study suggested that history of chronic kidney disease was not an independent risk factor for hospital mortality of AKI in patients with malignancy complicated with AKI, consistent with the literature [8, 9]. The reason may be related to the early kidney intervention of chronic kidney disease, and the high filtration and low sodium secretion of nephron in patients with chronic kidney disease have some influence on the process ofAKI; at the same time, pre-renal ischemia may also be one of the protection mechanisms for AKI [10].

The study analyzed the clinical features of malignancy patients complicated with AKI in 6 years who met the inclusion criteria, with the following deficiencies: (1) This study is a retrospective analysis; AKI outcomes were determined by serum creatinine values when the patients were discharged, lacking long-term prognosis indicators; (2) most patients in our hospital were in AKI 3 stage, and the proportion of patients in AKI l and 2 stages was small. Therefore, this study only represented the clinical features of one-center hospitalized AKI patients.

In short, AKI is a commoncomplication in patients with malignant tumors. Clinicians, in the treatment of cancer, should closely observe the changes in renal function and achieve early prevention and aggressive treatment for AKI to reduce the incidence and mortality of AKI.

Disclosure of conflict of interest

None.

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