Logistic Regression Analysis of Catheter Fixation Defects and Their Influencing Factors

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Abstract [**Objectives**] To analyze the influencing factors of fixed defects in patients with catheter fixation in clinical nursing work, in order to provide the best catheter fixation nursing plan for patients. [**Methods**] 176 inpatients with indwelling catheter from surgical system of Taihe Hospital in Shiyan City from August 2022 to March 2023 were selected. Using a retrospective analysis method, the influencing factors of catheter fixation defects in the study subjects were divided into two categories based on objective characteristics: type I non modifiable influencing factors and type II modifiable influencing factors. Using the standard for catheter fixation defects, whether the patient had catheter fixation defects was determined. After classified and statistically analyzed item by item, binary Logistic multiple regression analysis was used to identify the influencing factors. [**Results**] The occurrence of catheter fixation defects in patients with catheter fixation was related to factors such as whether the patient was evaluated before fixation, whether the fixation method was standardized and systematic, whether there was sufficient communication between nurses and patients, and the patient's knowledge of catheter fixation. It was also influenced by factors such as the patient's age, catheterization site, catheterization number, catheterization duration, where there was a consciousness disorder, educational level, and external environmental temperature. [**Conclusions**] Early attention to the key factors affecting patients with catheter fixation defects can effectively prevent adverse factors and provide patients with the best catheter fixation nursing plan to improve nursing quality.

Key words Catheter, Fixed defect, Influence factor, Logistic regression analysis

1 Introduction

Defects caused by technical service management and human error in the clinical nursing diagnosis and treatment process are collectively referred to as nursing defects[1]. Among them, due to the critical care and surgery, multiple catheters are often placed in patients. Catheter fixation is one of the most commonly used surgical techniques in clinical patient care. Its nursing results will directly affect the overall quality of nursing and the patient's disease recovery, and serve as a means of nursing treatment, observation, and the basis of prognosis judgment. Once operational errors occur, serious nursing defects may occur, causing pain to patients, delaying disease healing and prognosis, and even endangering life in severe cases[2]. Catheter fixation often requires the catheter system to be sealed, kept unobstructed, and avoid contamination, distortion, compression, bending, and detachment. Proper fixation and anti slip detachment are the primary issues in catheter fixation care[3]. In the process of clinical nursing, various defects in catheter fixation care are inevitable, and their occurrence is often influenced by various factors, including human intervention, material selection, environmental impact, operating methods, and other subjective, objective, controllable, and uncontrollable factors.

Using multivariate statistical method and retrospective analysis method, patients of retaining with fixed catheters from surgical system of Taihe Hospital in Shiyan City from August 2022 to March 2023 were randomly selected, in order to preliminarily explore and reveal the occurrence of catheter fixation defects and some factors that affect their occurrence. It aimed to provide some objective indicators for future clinical catheter nursing work, avoid controllable factors, reduce the incidence of catheter defects, and thus provide the best catheter fixation nursing plan for patients.

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2 Data and methods

2.1 Research objects 176 hospitalized patients (212 catheters) with indwelling catheters admitted to surgical system (including neurosurgery, cardiothoracic surgery, urology, general surgery, orthopedics, and hepatobiliary surgery) of Taihe Hospital in Shiyan City from August 2022 to March 2023 were selected as the study subjects. Among them, there were 42 cases of nasal insertion of tubes (including gastric tubes, duodenal tubes, and nasobiliary tubes), 35 cases of urinary tubes, 56 cases of cavity drainage tubes (including T-tubes, thoracoabdominal pelvic drainage tubes, incision drainage tubes, and fistula tubes), and 43 cases of oxygen delivery tubes. Among them, there were 98 males and 78 females. Age ranged from 7 to 78 years old, with an average of (54.85 ± 12.83) years old. The standard of whether the patient had catheter fixation defects was used to calculate the results of catheter fixation defects in the patients. Among the 176 patients, 76 had defects in catheter fixation, accounting for 43.18%; there were 100 patients without catheter fixation defects, accounting for 56.82%. All included studies met the following criteria.

2.2 Inclusion research criteria Based on the catheter care in quality assessment standards of basic nursing and specialized nursing, as well as literature[4-6], catheter fixation defects are defined as follows: no secondary fixation, exposed catheter is not fixed on the skin or dressing; adhesive tape soaked or loose, adhesive tape is soaked by secretions, oil stains, sweat stains and is not replaced, and adhesive tape is not tightly attached to catheters or skin; catheter induced skin indentation, after the catheter separates from the skin, the skin indentation cannot be restored within 5 min or the skin is damaged; catheter pulling or displacement, catheter pulling causes pain or catheter dislodgement, or the in-

serted length does not match the marked length during patient activity or passive movement; the drainage bag is not fixed and is placed in the toilet bowl or on the ground; catheter bending, compression or distortion causes catheter blockage or poor drainage. If one or more of the above criteria are met, it is considered that a catheter fixation defect has occurred and can be included in the study.

2.3 Exclusion criteria Patients who do not meet the above inclusion criteria and die during the catheter fixation process; patients who may experience restlessness and lack of consciousness due to anesthesia, pain, and other factors after major surgery, and may also engage in vigorous exercise or turning over in bed; patients with serious life-threatening primary diseases such as cardiovascular, cerebrovascular, hepatic, renal, and hematopoietic systems, as well as psychiatric disorders; other serious complications; dementia.

2.4 Research method Using a retrospective analysis method, through the nursing medical record management system, 176 patients with catheterization were numbered in order of admission, and their record information and occurrence of catheter defect events were retrieved for statistical analysis. The focus was on classifying and analyzing the included catheter defect event data, including the defect event's occurrence time, cause, patient age, catheter name, catheterization time, patient awareness and restraint status at that time, patient education level, nurse on duty situation and handling situation, *etc.* All possible influencing factors were recorded, the influencing factors were divided into two categories based on objective characteristics: modifiable and non modifiable factors, and them were recorded item by item. The two types of influencing factors were classified as follows based on whether there was a catheter fixation defect in hospitalized patients undergoing catheterization. Type I non modifiable influencing factors: sex (male, female), age (≤60 years old, >60 years old), ambient temperature (≤30 ℃, >30 ℃), catheterization site (≤1, >1), catheterization number (≤1, >1), catheterization duration (≤7 d, >7 d), where there is a consciousness disorder (yes, no), sources of medical expenses (medical insurance, rural cooperative medical insurance, self funded), degree of education (junior high school and below, high school to college, university or above). Type II modifiable influencing factors: whether the patient was evaluated before fixation (yes, no), whether the fixation method was standardized and systematic (yes, no), whether there was sufficient communication between nurses and patients (yes, no), the patient's knowledge of pipeline fixation (yes, no), whether the material was selected correctly (yes, no), where the skin is cleaned before fixation (yes, no), and whether the treatment load was too heavy (yes, no).

2.5 Statistical methods Double entry was performed using Epidata 3.0, and data analysis was conducted using SPSS 25.0 software package. The comparison of count data was conducted using chi-square test, and binary Logistic multivariate regression analysis with numerical independent variables was introduced. The independent variables were screened using the stepwise backward method, and the significance levels of the variables entering and remaining in the model were specified as 0.1. Standardized regression coefficients were calculated. The occurrence of catheter fixation defects in patients (occurred, not occurred) was taken as the dependent variable, and various influencing factors were taken as independent variables, with a test level of $\alpha = 0.05$.

3 Results and analysis

3.1 Results of type I non modifiable influencing factors In the type I non modifiable factors affecting catheter fixation defects, binary Logistic multivariate regression analysis showed that: the corresponding P values for gender and medical insurance cost sources were greater than 0.05, without statistical significance; the corresponding P values for age, environmental temperature, catheterization site, catheterization number, catheterization duration, consciousness disorder, and educational level were less than 0.05, with statistical significance. Thereby, it illustrated age ($OR = 0.426$, 95% CI of 0.230 – 0.790), ambient temperature ($OR = 0.169$, 95% CI of 0.086 – 0.332), catheterization site ($OR = 0.752$, 95% CI of 0.627 – 5.649), catheterization number ($OR = 0.818$, 95% CI of 0.463 – 3.520), catheterization duration ($OR = 6.832$, 95% CI of 2.463 – 11.421), consciousness disorder ($OR = 4.628$, 95% CI of 0.627 – 6.649), degree of education ($OR = 2.635$, 95% CI of 0.614 – 7.287) were important influencing factors of whether catheter fixation defects occurred in patients undergoing catheter fixation ($P < 0.05$), and it may not have much relationship with gender and the source of medical insurance expenses ($P > 0.05$).

3.2 Results of type II modifiable influencing factors Among the type II modifiable factors affecting catheter fixation defects, binary Logistic multivariate regression analysis showed that: the corresponding P values for whether the patient was evaluated before fixation, whether the catheter fixation method was standardized and systematic, whether there was sufficient communication between nurses and patients, the patient's knowledge of catheter fixation, whether the material was selected correctly, whether the skin was cleaned before fixation, and whether the treatment load was too heavy were all less than 0.05, which was statistically significant. Thereby, it illustrated that whether the patient was evaluated before treatment ($OR = 6.473$, 95% CI of 0.285 – 16.145), whether the fixed method was standardized and systematic ($OR = 0.986$, 95% CI of 0.442 – 18.131), whether there was sufficient communication between nurses and patients ($OR = 5.128$, 95% CI of 0.558 – 7.452), patient's knowledge of catheter fixation ($OR = 0.886$, 95% CI of 0.336 – 11.129), whether the material was selected correctly ($OR = 6.437$, 95% CI of 0.175 – 9.368), whether the skin was cleaned before fixation ($OR = 5.323$, 95% CI of 0.312 – 4.587), whether the treatment load was too heavy ($OR = 4.436$, 95% CI of 0.376 – 12.368) were important influencing factors of whether catheter fixation defects occurred in patients undergoing catheter fixation ($P < 0.05$).

3.3 Multivariate conditional Logistic regression analysis Variables with P values <0.05 or around 0.05 in the single-factor

conditional Logistic regression analysis of types I and II influencing factors were introduced into the conditional Logistic regression analysis equation for multivariate conditional logistic regression analysis. The inclusion criterion was $SLE = 0.05$, and the exclusion criterion was $SLS = 0.10$. The results indicated that among the type II modifiable influencing factors, whether the catheter fixation method was standardized and systematic, the patient's knowledge of catheter fixation, whether there was sufficient communication between nurses and patients, and whether the material was selected correctly were the risk factors for catheter fixation defects, and their *OR* values were 3.892, 5.420, 1.185, and 2.172 (Table 1).

Table 1 Multivariate conditional Logistic regression analysis results of catheter fixation defects

β	SE	Wald value	*P* value	*OR* value	95% *CI*
1.376	0.406	11.580	0.000	3.892	1.842 – 6.712
1.255	0.335	13.458	0.000	5.420	2.007 – 12.563
0.186	0.506	3.986	0.037	1.185	1.333 – 0.496
0.653	0.085	4.181	0.031	2.172	1.012 – 4.561

4 Discussion

Catheter fixation defects were related to factors such as whether the patient was evaluated before fixation, whether the fixation method was standardized and systematic, whether there was sufficient communication between nurses and patients, the patient's knowledge of catheter fixation, whether the material was selected correctly, whether the skin was cleaned before fixation, and whether the treatment load was too heavy. In addition, they were also affected by factors such as the patient's age, catheterization site, catheterization number, catheterization duration, whether there was consciousness disorder, educational level, and external environmental temperature[3-6]. In the binary Logistic multivariate regression analysis of type I non modifiable influencing factors, consciousness disorder was an important factor affecting catheter fixation defects, and age was also an important factor affecting catheter fixation. Additionally, catheterization site, catheterization number, and catheterization duration also affected the incidence of catheter fixation defects, and it was generally positively correlated with these three indicators. The ambient temperature may also affect the outcome of catheter fixation defects. In addition, cultural level may also affect the incidence of catheter fixation defects. The higher the cultural level, the lower the incidence of catheter fixation defects, which may be related to the patient's higher cultural level and greater emphasis on quality of life. The analysis also showed that gender and cost sources may not have a significant impact on the catheter fixation defects. The cost source was closely related to the patient's economic factors, which may affect the selection of catheter fixation materials. In addition, if considering only one type of catheter fixation, gender differences may also have an impact. In this paper, the selection of tube placement categories was relatively broad, but the observation sample was small. Further precise results and research to expand the sample size were needed in the later stage.

Among the type II modifiable factors, binary Logistic multivariate regression analysis showed that whether the patient was evaluated before fixation, whether the fixation method was standardized and systematic, whether there was sufficient communication between nurses and patients, the patient's knowledge of catheter fixation, whether the material was selected correctly, whether the skin was cleaned before fixation, and whether the treatment load was too heavy were important influencing factors for catheter fixation defects. Similar reports have been made in previous literature[7-8]. Patients were generally evaluated before fixation, such as high-risk factors for catheter dislodgement, their mental state, and other general conditions. Timely measures and effective constraint management can be taken, which will directly affect the defect rate of catheter fixation. The more standardized the operation and guidelines of catheter fixation, the fewer cases of defects will occur. In the process of carrying out catheter nursing, it is found that by providing standardized training to all nurses and improving the traditional cross fixation method to fix drainage tubes, the fixation of drainage tubes was more secure, reducing the probability of tube slippage when patients changed positions, and the risk of pressure ulcers on the patient's skin caused by the tubes. The more sufficient the communication between nurses and patients, the fewer catheter fixation defects will occur. After adjusting for multiple factors, whether the catheter fixation method was standardized and systematic, the patient's knowledge of catheter fixation, whether the communication between nurses and patients was sufficient, and whether the material was selected correctly, were still independent risk factors for catheter fixation defects.

Due to the limited conditions and level of research in this paper, the avoidable factors can only be considered in future clinical nursing work, and it could guide the adoption of countermeasures and continuous improvement of catheter fixation nursing methods.

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