Scientific Research Publishing

Investigation and Analysis of Catheter-Associated Skin Impairment in PICC's Patients in Jingzhou City

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Abstract

Objective: To understand the status quo of PICC Catheter-associated Skin Impairment (CASI) in some hospitals at all levels in Jingzhou city, and to explore the risk factors for PICC Catheter-associated Skin Impairment. Methods: From June 2019 to July 2020, a self-made questionnaire for CASI status was used to facilitate the extraction of CASI patients in PICC in some hospitals at all levels in Jingzhou city. Local skin lesions were collected and classified during PICC maintenance, and the damage types, occurrence frequency and related influencing factors of CASI were counted to identify independent risk factors. Results: In this study, there were 173 cases of CASI in PICC's patients including local infection 56.1% (97/173), exudation at the puncture site 16.8% (29/173), irritant dermatitis 21.4% (37/173), allergic dermatitis 4.6% (8/173), and tension injury 1.2% (2/173). After univariate analysis, there were statistically significant differences between CASI occurrence type and duration of catheter wear, age, underlying disease, skin moisture and hyperhidrosis, PICC maintenance as required, hospital grade maintenance and intermittent chemotherapy ($P < 0.05$). Then, disordered multiple Logistic regression analysis was performed, and exudation at the puncture site was used as the reference group. The results showed that patients with PICC were more likely to have CASI if they were aged, long catheter time, had diabetes, had moist and sweaty skin, and were in the intermittent stage of chemotherapy. Conclusion: The incidence of CASI is high in patients aged 70 - 79 years, and local infection is the most common. PICC's patients with diabetes are at high risk of CASI. PICC's patients with excessive sweating are more likely to have CASI. The intermittent stage of chemotherapy is the excessive CASI; time with tube affects CASI occurrence.

1. Introduction

At present, there is no uniform definition of CASI. Broadhurst *et al.*, based on Medical Adhesive Skin Iesion (MARSI), and Catheter-associated Skin Impairment (CASI), refer to various skin abnormalities, including pus, red patches, erosion, or tearing, occurring in the PICC Catheter site and surrounding skin [1]. CASI mainly includes contact dermatitis, mechanical injury, puncture point exudation, local infection and pressure injury [1]. In domestic studies, there are few studies on CASI, and medical workers pay more attention to contact dermatitis, MARSI and exudation at the puncture site of PICC implantation [2] [3]. Therefore, taking CASI as the starting point, this study made a self-made survey tool for PICC Catheter-associated Skin Impairment, investigated the current situation of CASI occurrence in PICC's patients in some hospitals at all levels in Jingzhou city, and discussed the risk factors for PICC Catheter-associated Skin Impairment.

2. Objects and Methods

2.1. Research Objects

A self-made CASI status questionnaire was used from June 2019 to July 2020, and the samples were randomly selected CASI occurred in 173 patients with PICC in some hospitals at all levels in Jingzhou City. Inclusion criteria: ① PICC's patients have been carried out; ② Age ≥ 18 years old; ③ The patient has no cognitive, verbal or intellectual dysfunction; ④ Patients who volunteered to participate in the study. Exclusion criteria: ① Congenital or pre-existing skin diseases; ② Patients with skin allergy. 173 patients were included in this study, including head and neck tumor (nasopharyngeal carcinoma in 10 cases; 3 cases of laryngeal cancer); Thoracic tumors (8 cases of esophageal cancer; Lung cancer in 27 cases); 40 cases of breast cancer; Abdominal tumor (gastric cancer in 10 cases; Three cases of liver cancer; One case of colon cancer; 11 cases of rectal cancer; 7 cases of pancreatic cancer); Female reproductive system tumors (cervical cancer: 3 cases; 13 cases of ovarian malignant tumor; 4 cases of fallopian tube malignant tumor; Endometrial carcinoma (3 cases); Hemolytic lymphatic system tumors (leukaemia: 11 cases; 3 cases of bone marrow carcinoma; Lymphoma was found in 6 patients. Severe aplastic anemia: 1 case); Tumor of central nervous system (7 cases of intracranial tumor).

2.2. Research Methods

2.2.1. Research Tools

The "CASI questionnaire" was designed by myself by referring to literature and combining with clinical experience, and then Delphi was conducted in this study, 3 rounds of expert consultation were conducted, and 11 experts partici-

pated in the consultation process. Their professional directions include nursing management, nursing research, nursing education and clinical nursing. Finally, a questionnaire was formed after expert consultation for data collection. The questionnaire is mainly divided into four parts: general information (gender, education background, age, BMI, smoking history and drinking history); The patient's disease information; PICC and maintenance information; CASI information (type of occurrence).

2.2.2. Survey Methods

Three weeks before the study, the investigators were trained on CASI knowledge and precautions. The general data of the questionnaire, disease data, PICC and Maintenance data section were obtained and recorded by inquiring or consulting the inpatient medical records of the study subjects, catheter data and catheter maintenance manual. The data of CASI were based on the abnormal conditions of the local skin of the PICC's patients, and the investigators determined the type of CASI occurrence according to the relevant training knowledge, and filled in the specific time of occurrence.

2.3. Statistical Treatment

SPSS19.0 statistical software was used for data analysis and processing, and descriptive analysis was conducted for counting data frequency, percentage, measurement data mean and standard deviation. Input all CASI data and related information into SPSS19.0, and statistically describe and analyze the occurrence of all types of CASI. Univariate analysis of variance (ANOVA) and Chi-square test was used to analyze the influencing factors of CASI, and $P < 0.05$ was considered statistically significant. Univariate analysis of variance (ANOVA) and Chi-square test ($P < 0.05$) were then included in the Logistic regression model for unordered multiple classification Logistic regression analysis, and $P < 0.05$ was considered as statistically significant difference.

3. The Results

1) Occurrence of CASI, a total of 173 cases of CASI were included in this study, among which local infection, puncture site exudation, mechanical injury and contact dermatitis occurred in sequence. See Table 1 for details.

2) Influence factor analysis of CASI in PICC's patients through single factor analysis of different observation items. The results showed that the duration of the catheter, age, basic diseases, wet and sweaty skin, PICC maintenance as required, hospital grade maintenance and chemotherapy intermission were statistically significant are shown in Table 2.

3) Patients with PICC CASI more disorderly classification to the single factor

Logistic regression analysis, chi-square analysis was statistically significant with tube time, age, basic diseases, skin is damp sweat, if according to the provisions of PICC maintenance, maintenance level of hospital and whether in intermittent chemotherapy period more than seven influencing factors into the disorderly

Table 1. CASI incidence in 173 patients with PICC.

	Local infection	Exudation at the puncture site	Contact dermatitis		Mechanical damage
			Irritant dermatitis	Allergic dermatitis	Tension damage
The number of cases	97	29	37	8	2
The percentage (%)	56.1	16.8	21.4	4.6	1.2

Table 2. Single factor analysis of CASI in PICC's patients.

		Local infection		Exudation at the puncture site		Contact dermatitis				Mechanical damage			F/X^2	P
						Irritant dermatitis		Allergic dermatitis		Tension damage				
		The number of cases	The percentage (%)	The number of cases	The percentage (%)	The number of cases	The percentage (%)	The number of cases	The percentage (%)	The number of cases	The percentage (%)	The number of cases		
Gender													1.86	0.635
	Female	45	46.40	11	37.90	16	43.20	4	50.00	0	0.00	76		
	Male	52	53.60	18	62.10	21	56.80	4	50.00	2	100.00	97		
Age													22.07	0.014
	18 - 39	11	11.30	6	20.70	5	13.50	0	0.00	0	0.00	22		
	40 - 59	17	17.50	11	37.90	8	21.60	3	37.50	1	50.00	40		
	60 - 69.	40	41.20	11	37.90	20	54.10	5	62.50	1	50.00	77		
	70 - 79.	29	29.90	1	3.40	4	10.80	0	0.00	0	0.00	34		
BMI													20.08	0.186
	Normal: 18.5 - 23.9	67	69.10	19	65.50	21	56.80	5	62.50	2	100.00	114		
	Overweight: 24 or more	15	15.50	3	10.30	4	10.80	0	0.00	0	0.00	22		
	Overweight: 24 - 27.9	6	6.20	0	0.00	5	13.50	2	25.00	0	0.00	13		
	Obesity: 28 or higher	2	2.10	0	0.00	0	0.00	0	0.00	0	0.00	2		
	Lean: 18.5 or less	7	7.20	7	24.10	7	18.90	1	12.50	0	0.00	22		
Record of formal schooling													14.89	0.247
	Illiteracy	6	6.20	1	3.40	3	8.10	2	25.00	0	0.00	12		
	Primary school	23	23.70	12	41.40	12	32.40	1	12.50	1	50.00	49		
	Junior high school	30	30.90	5	17.20	11	29.70	1	12.50	0	0.00	47		
	High school	21	21.60	2	6.90	7	18.90	3	37.50	0	0.00	33		
	Junior College and above	17	17.50	9	31.00	4	10.80	1	12.50	1	50.00	32		

Continued

												23.58	0.04
Basic diseases	No	38	39.20	20	69.00	25	67.60	3	37.50	1	50.00	87	
	Liver and kidney disease	8	8.20	2	6.90	1	2.70	2	25.00	0	0.00	13	
	Hypertension	11	11.30	0	0.00	1	2.70	0	0.00	0	0.00	12	
	Anemia	3	3.10	3	10.30	3	8.10	0	0.00	0	0.00	9	
	Diabetes	33	34.00	3	10.30	6	16.20	3	37.50	1	50.00	46	
	Heart disease	4	4.10	1	3.40	1	2.70	0	0.00	0	0.00	6	
												20.61	0.000
Whether the skin is moist and sweaty	Yes	69	71.10	9	31.00	28	75.70	6	75.00	0	0.00	112	
	No	28	28.90	20	69.00	9	24.30	2	25.00	2	100.00	61	
The tube time					66.91 +/− 56.12								1.584	0.02
												2.12	0.564
Catheter site	Upper left	38	39.20	10	34.50	19	51.40	3	37.50	1	50.00	71	
	Upper right	59	60.80	19	65.50	18	48.60	5	62.50	1	50.00	102	
												4.66	0.191
PICC type	Triple valve type	89	91.80	27	93.10	29	78.40	7	87.50	2	100.00	154	
	Resistance to high pressure type	8	8.20	2	6.90	8	21.60	1	12.50	0	0.00	19	
												10.87	0.01
Whether to maintain PICC according to regulations	Yes	82	84.50	28	96.60	37	100.00	8	100.00	2	100.00	157	
	No	15	15.50	1	3.40	0	100.00	0	100.00	0	100.00	16	
												10.45	0.009
Maintain hospital grade	The secondary	60	61.90	16	55.20	14	37.80	2	25.00	0	0.00	92	
	Level 3	37	38.10	13	44.80	23	62.20	6	75.00	2	100.00	81	
												1.92	0.572
Maintenance personnel	PICC's specialist nurse	23	23.70	10	34.50	10	27.00	3	37.50	0	0.00	46	
	In-hospital training of nurses	74	76.30	19	65.50	27	73.00	5	62.50	2	100.00	127	
												8.64	0.023
Interchemotherapy period	Yes	45	46.40	5	17.20	16	43.20	1	12.50	1	50.00	68	
	No	52	53.60	24	82.80	21	56.80	7	87.50	1	50.00	105	

classification Logistic regression analysis, the independent variable assignment are shown in Table 3. With exudation at the puncture site as the reference group, the results showed that PICC's patients with catheter duration of 150 - 199 days, diabetes, moist and sweaty skin, and intermittent chemotherapy were more likely to have local infection of CASI (OR > 1.0, P < 0.05). PICC's patients with moist and sweaty skin and intermittent chemotherapy were more likely to develop contact dermatitis with CASI (OR > 1.0, P < 0.05). Compared with patients aged 70 - 79

Table 3. Assignment methods of independent variables.

The independent variables	Assignment way
The tube time	1 - 49 = 1; 50 - 99 = 2; 100 - 149 = 3; 150 - 199 = 4; ≥5200
Age	18 - 39 = 1; 40 - 59 = 2; 60 - 69 = 3; 70 - 79 = 4
Basic diseases	No = 1; Liver and kidney disease =2; Hypertension =3; Anemia = 4; Diabetes =5; Heart disease = 6
Maintain hospital grade	Level 2 = 1; Level 3 = 2
Whether the skin is moist and sweaty	Yes = 1; No = 2
Whether to maintain according to regulations	Yes = 1; No = 2
Whether in the chemotherapy intermission period	Yes = 1; No = 2

Table 4. Multivariate logistic regression analysis of CASI influencing factors.

Value		Local infection					Contact dermatitis					Mechanical damage				
		B	P	The OR Value	95% CI		B	P	The OR Value	95% CI		B	P	The OR Value	95% CI	
					The lower limit	Ceiling				The lower limit	Ceiling				The lower limit	Ceiling
The tube time	1 - 49	−13.24	0.996	0.00	0.00	.b	−15.43	0.995	0.00	0.00	.b	−70.70	0.998	0.00	0	.b
	50 - 99	−8.48	0.997	0.00	0.00	.b	−11.40	0.997	0.00	0.00	.b	−83.77	0.998	0.00	0	.b
	100 - 149	−11.35	0.997	0.00	0.00	.b	−14.26	0.996	0.00	0.00	.b	−54.57	0.999	0.00	0	.b
	150 - 199	4.23	0.017	68.66	2.15	2189.10	1.05	.	2.87	2.87	2.87	−40.53	0.999	0.00	0	.b
	>200	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.
Age	18 - 39	−3.77	0.022	0.02	0.00	0.59	−2.49	0.154	0.08	0.00	2.55	−6.3	0.999	0.00	0	.b
	40 - 59	−4.95	0.002	0.01	0.00	0.17	−2.87	0.094	0.06	0.00	1.62	27.19	0.996	$6*10^{+12}$	0	.b
	60 - 69	−3.28	0.034	0.04	0.00	0.77	−1.23	0.448	0.29	0.01	7.00	−2.41	1.00	0.09	0	.b
	70 - 79	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.
Basic diseases	No	1.41	0.368	4.09	0.19	87.23	2.08	0.237	7.99	0.26	249.50	−26.12	0.998	0.00	0	.b
	Liver and kidney disease	2.72	0.152	15.10	0.37	622.62	2.56	0.224	12.95	0.21	803.94	−23.54	0.999	0.00	0	.b
	Hypertension	19.93	0.995	$4 \times 10^{*9}$	0.00	.b	18.37	0.996	$9 \times 10^{*9}$	0.00	.b	−41.45	0.998	0.00	0	.b
	Anemia	−0.25	0.891	0.78	0.02	25.87	1.48	0.445	4.41	0.10	198.30	−12.73	0.999	0.00	0	.b
	Diabetes	4.04	0.028	57.03	1.53	2120.89	3.95	0.052	51.72	0.96	2788.52	−8.94	1.00	0.00	0	.b
	Heart disease	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.
Maintain hospital grade	Level 2	0.27	0.702	1.31	0.33	5.17	−0.92	0.184	0.40	0.10	1.55	−31.60	0.988	<0.000	0	.b
	Level 3	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.
Whether the skin is moist and sweaty	Yes	1.88	0.006	6.58	1.72	25.21	1.95	0.004	7.03	1.88	26.30	−30.40	0.986	<0.000	0	.b
	No	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.
Whether to maintain according to regulations	Yes	−1.93	0.371	0.15	0.00	9.94	16.15	.	10*8	10*8	10*8	−15.86	0.998	<0.000	0	.b
	No	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.
Whether in the chemotherapy intermission period	Yes	1.92	0.009	6.80	1.63	28.41	1.55	0.031	4.73	1.16	19.37	16.41	0.993	10*8	0	.b
	No	0c	.	.	.	.	0c	.	.	.	.	0c	.	.	.	.

years, patients aged 18 - 69 years were less likely to develop local infection of CASI, OR < 1.0, P < 0.05, and patients aged 70 - 79 years were more likely to develop local infection of CASI. As shown in Table 4.

4. Discuss

In this study, there were 173 cases of CASI, including 56.1% (97/173) of local infection, 16.8% (29/173) of exudation at the puncture site, 21.4% (37/173) of irritant dermatitis, 4.6% (8/173) of allergic dermatitis, and 1.2% (2/173) of tension injury. Among them, local infection accounted for the largest proportion in CASI type, and mechanical injury was relatively rare. Ullman *et al.* [4] reported that in CASI with 10,859 vascular pathways (PICC, CVC, Port, etc.), local infection or mechanical injury was relatively rare. The differences in these data may be related to our research methods, sample size and the particularity of the population. Therefore, the prevalence of CASI varies from care unit to care unit and from population to population, and the care of CASI is very important.

CASI related risk factors of PICC's patients in this study, disordered multiple Logistic regression analysis showed that PICC's patients were more likely to have CASI if they were aged, long catheter time, had diabetes, had moist and sweaty skin and had intermittent chemotherapy. 1) Age: The skin of the elderly is loose and thin, atrophic, and the moisturizing function declines, and the skin barrier function will weaken [5]; At the same time, elderly patients will appear aging and aging caused by self-care ability limited, cognitive dysfunction and other problems [6], leading to poor compliance with catheter maintenance, poor mastery of health education knowledge, and poor ability of self-management in home maintenance, etc. [7]. Some elderly patients are prone to malnutrition, resulting in the skin blood supply and nutritional status of patients affected, skin resistance decreased. Therefore, elderly patients are more likely to develop CASI. 2) Diabetes: Skin lesions are one of the most common complications of diabetes, and 33% - 91% of diabetic patients will have one or more skin lesions [8]. Surgical wounds will be formed after PICC [1], and such exogenous wounds will cause skin injuries [9] [10]. At the same time, the epidermal thickness of diabetic patients was thinner, the epidermal layer was significantly reduced, the inflammatory mediators in local tissues were abnormally increased, and the biological behavior of epidermal keratinocytes was changed [11], making PICC's patients more prone to CASI. 3) Sweat: The skin is covered by a film for a long time, and the skin sweat accumulates and is not volatile under the fixation of the dressing [12]. In addition, the ordinary transparent dressing cannot remove the sweat, so the patient's skin chafes against the clothes, and the dressing tends to be moist, hemmed and sweaty, leading to an increased probability of skin allergy or skin reaction [13]. Seasonal changes affect the number of colonizing bacteria on the skin surface. Moist skin, higher oil content and higher temperature will lead to more colonizing bacteria on the skin surface [14]. In summer, patients' easy sweating will also cause CASI in PICC's patients. 4) Interval of chemotherapy:

Zheng Yan [15] *et al.* conducted a study on family function and self-management of PICC's patients in Xinjiang during the interval of chemotherapy, and 31.88% of patients had poor self-management ability of PICC. 40.58% of those with medium level; 27.54% of the respondents were the better ones [15], the main reasons are as follows: catheter maintenance and inconvenience in surrounding towns and rural areas; The cause of the patient's illness, the length of the illness, the suffering of the disease [15]; The increase of economic burden, coupled with the deterioration of family functions [15] [16]; It reduces the catheter maintenance compliance of PICC's patients and increases the incidence of CASI in PICC's patients. 5) The tube time: When PICC catheter is inserted and surgical wounds are formed, fibrin sheath will surround them and a fibrous membrane will be formed, thus becoming a good parasitic site for microorganisms and not susceptible to the effects of host phagocytes and antibiotics [17] Skin colonized microorganisms migrate along the ducts and the patient may be at risk of local or systemic infection [18]. Therefore, the longer the PICC indwelling time, the higher the bacterial colonization rate of the catheter [14]. PICC retention time also affects CASI.

5. Summary

In summary, according to the age, diabetes, sweat, chemotherapy interval and catheter duration in PICC's patients in this study, CASI risk factors should be prevented, effective measures should be taken to improve the CASI related management system for nursing care, so as to reduce the incidence of CASI. Limitations of this study: The sample size was single and small, which could not completely represent the group of PICC's patients. This study is a descriptive study and only provides an objective description of the occurrence of CASI. In the future, a cohort study can be conducted in a more representative large sample population to investigate whether CASI has occurred or not, and to analyze and discuss influencing factors of CASI.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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