



Application of Nursing Quality Index Management in Reducing Tunneled-Cuffed Hemodialysis Catheter

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Abstract

Objective: To explore how the nursing quality management reduces the infection of tunneled-cuffed hemodialysis catheter (TCC).

Methods: The TCC infection rate from January 1st to December 31st was used as the baseline data, and the TCC infection rate from January 2014 to December 2017 was used for annual comparison. Through the nursing quality index management mode, the TCC infection rate was compared quarterly, annually and year by year by taking the measures of joint wards checking, optimizing nursing process, analyzing the root cause of infection cases and formulating countermeasures.

Results: The number of TCC patients and indwelling catheter days increased year by year from 2013 to 2017, but the rate of TCC infection decreased year by year.

Conclusion: The nursing quality index management can effectively reduce the incidence of TCC infection.

Keywords: Nursing quality index; Hemodialysis; Catheter-associated infection; CRI

Introduction

In China, the number of maintenance hemodialysis (MHD) patients has increased dramatically. According to the statistics of the National Blood Purification Case Information Registration System, the growth rate of MHD patients in China from 2011 to 2014 was as high as 44.9%, ranking the second in the world and the fastest in the world [1]. Vascular access is the lifeline of MHD patients. Central venous catheter as a vascular access is widely used in clinical dialysis, and catheter related infections (CRI) is one of the main complications [2] and the main causes of the catheter dysfunction. It has serious influence to patients with hemodialysis, resulting in patients extending the hospitalization. Severe cases can cause deaths [3]. In order to reduce the occurrence of CRI and reduce the pain and economic burden of patients, the center applied the nursing quality index management to the management of CRI and achieved better results.

Materials and Methods

General information

All the cases were selected from hemodialysis patients using

TCC in our center from January 1, 2013 to December 31, 2017. There were a total of 434 cases, aged from 6 to 93 years old. The primary diseases were hypertensive nephropathy, diabetic nephropathy, chronic glomerulonephritis, cystic nephropathy, obstructive nephropathy and so on. The TCC detention period was from 2 months to 7 years. Catheterization was performed in 426 cases of the right internal jugular vein, 7 cases of the left internal jugular vein and 1 case of the right femoral vein. Hemodialysis was performed three times a week for 4 hours each time.

Basis for definitions of catheter-related infection

1. Catheter outlet infection: infection within 2cm of catheter outlet.
2. Duct tunnel infection: Infection within the subcutaneous tunnel of the catheter more than 2cm away from the outlet.
3. Catheter related blood stream infection (CRBSI): Bacteremia or septicemia caused by a partial infection in the lumen or blood vessel that spreads into the blood stream [4].
4. Two methods were used to calculate the annual TCC infection rate. The internationally accepted 1000-day rate of infection was calculated as = infection cases/catheter days × 1000. Method 2 the catheter infection rate was calculated by comparing the number of infections with the total number of patients = infections/patients × 100.

Research methods

The patient's basic information and TCC conditions were collected from January 2013 to December 2013 was used as the baseline data and compared with the annual TCC infection rate from January 1, 2014 to December 31, 2017.

Statistical methods

SPSS 23.0 Software was used for statistical analysis of the

Submitted: 11 February 2020 | **Accepted:** 21 February, 2020 | **Published:** 24 February, 2020

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Citation: Liu H, Li F, Liu F, Chen Y (2020) Varenicline and Involuntary Intoxication: Forensic Implications. SM J Nurs 6: 4. doi: <https://dx.doi.org/10.36876/smjn942651>



data, and the counting data were expressed as rate. χ^2 test was used, and $P < 0.05$ was considered as statistically significant.

Results

General information of the 434 patients

The basic information of the 434 patients was as follows: 217 males and 217 females, with an average age of 61.47 ± 16.56 . The original diseases - there were 141 cases of hypertensive nephropathy (32.5%), 105 cases of diabetic nephropathy (24.2%), 56 cases of chronic glomerulonephritis (12.9%), 27 cases of cystic nephropathy (6.2%), 63 cases of obstructive nephropathy (14.5%), 13 cases of nephrotic syndrome (3.0%), 4 cases of acute kidney injury (0.9%), and 25 cases of other primary diseases (5.8%). The average catheter detention days were 180 ± 325.077 . See Table 1.

Distribution of pathogenic bacteria

From 2013 to 2017, there were 60 cases of catheterization infection in TCC patients, among which pathogenic bacteria were detected in 13 patients, with a positive detection rate of 21.67%. Among them, there were 5 cases of *staphylococcus aureus*, 1 case of *staphylococcus epidermidis*, 1 case of gram-positive cocci, 1 case of *staphylococcus vorchii*, 1 case of *acinetobacter baumannii*, 1 case of *colorobacillus denitrifying*, 1 case of *sarrella mucilis*, 1 case of *staphylococcus cephalus* and 1 case of *pseudomonas aeruginosa*. This result is similar as the report of Yuhong Pang and Jun Wang et al. [5,6], in China, as well as the reports abroad [7]. *Staphylococcus aureus* remains the most common infectious pathogen.

Statistical results

The number of TCC patients and indwelling catheter days in-

creased year by year from 2013 to 2017, while the total infection rate decreased, as shown in Table 2. As shown in Table 2, after comparison, the infection rate of TCC showed a decreasing trend ($\chi^2=11.34$, $P=0.023$). From 2013, pairwise comparison was conducted for the infection rate every two years. The comparison between 2013 and 2014 ($\chi^2=4.20$, $P=0.04$) was $P < 0.05$, which was statistically significant. Compare the other years in pairs. The comparison between 2014 and 2015 ($\chi^2=0.00$, $P=0.10$), 2015 and 2016 ($\chi^2=0.03$, $P=0.85$), 2016 and 2017 ($\chi^2=1.35$, $P=0.25$) result was $P > 0.05$, which was not statistically significant.

Nursing

The quality index management was implemented in the first quarter of 2014, and a vascular access management team was set up, with the head nurse as the group leader and the nursing core staff as the team members. Each team member oversaw the corresponding quality index, and the TCC specialist in the group was responsible for the statistics and analysis of its use.

The registration form of TCC was formulated

The nurses in each shift recorded and transferred the abnormal situation of TCC in the shift. The TCC specialist executed timely integrated medical checking to TCC infection cases. They developed and implemented treatment and nursing planF together. TCC specialist collected data every quarter, controlled the nursing quality of the TCC, analyzed the problems existing in the record, and found out the root cause of the infection (from people, machine, material, method or checking). The specialist would also personalize solutions to problems, train the nurse how to solve common problems, optimize the procedure and supervise the implementation.

Studies have shown [8,9] that catheter infection is related to catheter interface contamination, skin bacterial transitional contamination of puncture site, hemoperfusion contamination, catheter material, bacterial biofilm, internal characteristics of pathogens and other factors. Studies have shown that [10] cluster nursing can effectively reduce the incidence of catheter infection. Since 2014, our department has continuously revised and optimized the guidelines for catheter opening and sealing and catheter dressing change, implemented personalized dressing change procedures for patients with different conditions, bound them into books and organized medical staff in the department to conduct training and learning.

For TCC patients, guidance was offered to them on sensory control at home. They could choose to wrap plastic wrap around the shoulder of the catheter during shower to cover the entire catheter or clean the covered area after shower or put the external part of the catheter into the anal bag, with the adhesive layer of the anal bag around the catheter mouth, remove the disposable anal bag after shower, and then re-fix the exposed part of the catheter in front of the chest wall. Lectures on catheter maintenance were given to patients no less than twice a year, and special guidance was given by the nurse in charge of each dialysis.

Training of nursing personnel: all the new and advanced nurses received the theoretical and operational training of

Table 1: Basic Information of Patients (N = 434).	
Project	Value (N=434)
Age (years old)	61.47 ± 16.56
Gender	
Male	217 (50%)
Female	217 (50%)
Original diseases	
Hypertensive nephropathy	141 (32.5%)
Diabetic Nephropathy	105 (24.2%)
Chronic glomerulonephritis	56 (12.9%)
Cystic nephropathy	27 (6.2%)
Obstructive nephropathy	63 (14.5%)
Nephrotic syndrome	13 (3.0%)
Acute kidney injury	4 (0.9%)
Others*	25 (5.8%)
Catheter Detention (days)	180 ± 325.077
Note: Others include drug-induced renal damage, membranous nephropathy, multiple myeloma, lupus nephritis, hemolytic uremic syndrome, ANCA-associated vasculitis, hepatitis b-associated nephritis, and purpura nephritis.	



Table 2: The Infection of Patients with Long-Term Catheterization of Hemodialysis in this Center.

Year	Patient Cases	Detention days	Total infection		Catheter outlet infection		Duct tunnel infection		CRBSI	
			Infection cases n(%)	1000-day rate of infection(‰)	Infection cases n(%)	1000-day rate of infection(‰)	Infection cases n(%)	1000-day rate of infection(‰)	Infection cases n(%)	1000-day rate of infection(‰)
2013	41	7553	9(21.95)	1.19	7(77.78)	0.93	0(0.00)	0.00	2(22.22)	0.26
2014	101	10314	8(7.92)	0.78	7(87.50)	0.68	0(0.00)	0.00	1(12.50)	0.10
2015	189	16110	15(7.94)	0.93	10(66.67)	0.62	0(0.00)	0.00	5(33.33)	0.31
2016	215	21123	16(7.44)	0.76	10(62.50)	0.47	1(6.25)	0.05	5(31.25)	0.24
2017	247	23408	12(4.86)	0.51	9(75.00)	0.38	1(8.33)	0.04	2(16.67)	0.09

dialysis catheter opening, dressing changing and sealing, and shall not conduct the above operations independently before passing the examination of operation and theory. Unnecessary opening times of catheter ports during dialysis were avoided. For poor catheter flow and reverse connection of arteriovenous ports, nurses were required to perform hand hygiene, wear sterile gloves to separate catheter and blood line catheter, and reduce exposure time of catheter ports. There would be blood scab formation at the thread of the catheter after the reverse connection. It was required that the nurse should use disinfectant gauze to clean the blood scab when getting off. After there was no blood scab left, the sterile disinfection process should be carried out. They had to put the sterile plug to protect the catheter port, preventing blood scabs from entering the catheter and reducing the risk of infection

To find out the regularity or seasonality of TCC infection. From statistical records, we found that each year in the 3rd quarter TCC infection rate had a rising trend. Through the integration of medical ward inspection, analysis and discussion, we found that the third quarter in Guangzhou (7 September) was usually hot and the stay-home patients would easily sweat. Guangzhou people like to take shower, and the catheter dressing exposed to water. We selected different dressings for different patients. For patients with a certain level of knowledge and good learning ability, we guided them to change the dressing for the catheter at home, and the catheter infection was better controlled.

Discussion

TCC infection rate is one of the important indicators to measure the quality of hemodialysis, and the incidence of CRBSI has been reported to be on the rise, which is one of the common complications of maintenance hemodialysis patients [11]. There have been many clinical reports on the use of antimicrobial agents to seal tubes to prevent catheter-related infections [12,13], but it is easy to cause bacterial resistance, increase the risk of fungal infection, and increase the economic burden of patients. Non-antimicrobial agents have also been used to seal catheters to control catheter-related bacteremia [14]. Since the implementation of quality index management of hemodialysis nursing in our dialysis center, root cause analysis has been conducted for TCC infection cases. Sensitive antibiotics have been selected for sealing for more than 3 weeks for CRBSI patients

according to etiological data, and the compatibility of antibiotics and heparin has been noted. It has been reported in the literature [15] that the extending the prophylaxis of antibiotic sealing tube to 1-2 weeks can consolidate the curative effect, and prophylactic antibiotic sealing tube is not recommended.

Hypertensive nephropathy has occupied the first place in the primary disease in our center. Foreign studies have shown that hypertension is an independent risk factor for catheter infection, and the related reasons are as follows: hypertension is often associated with diabetes or atherosclerosis, increasing the risk of infection [16], some antihypertensive drugs may help to increase the risk of infection [17], Hypertension affects capillaries in the skin and increases bacterial colonization of catheter [18]. Therefore, the joint management of hypertension and its complications has become a top priority. For patients with hypertension, the focus of nursing in dialysis is to monitor the changes of blood pressure on time and focus on the changes of patients' mental state. Strengthen home blood pressure health education for patients, distribute home blood pressure monitoring record books, teach patients to measure blood pressure correctly, record accurately, take medicine on time, control blood pressure within the ideal range, delay the occurrence or development of complications, in order to reduce the incidence of catheterization infection. The patient was taught to observe the dressing in the catheterization place and the surrounding skin condition correctly at home, find the abnormal situation in time, and seek medical advice in time.

The prevention of catheter-related infections is not only a nursing problem, but also a joint effort of three parties. Studies have shown that [19] under the management of clustered nursing, certain effects have been achieved in reducing the rate of catheter infection. The first is aseptic operation during catheterization by the physician, followed by catheter nursing during each dialysis session, and then catheter nursing at home for the patient. TCC catheterization was performed in a sterile operating room, so the emphasis was on catheter nursing during each dialysis session and patient nursing at home. Each dialysis nursing is influenced by three factors: environment, process and nurse operation. In the case of poor indoor ventilation and crowded personnel, if there are diseased primary microorganisms in the air, the pathogens can be ejected along with the droplets through conversation, cough and sneeze, so as to cause infection in susceptible people [20]. Therefore, the center does not leave accompanying people



on, off, and when opening or sealing the tube and patients with catheters must wear disposable masks. Clearing the field between the two classes of patients, opening the window for ventilation and reducing the number and activity of indoor staff, reduce the concentration of pathogens in the air, and thus reduce the infection rate. The most difficult factor to control in these three aspects is the patient side, so we value proper in-home catheter nursing for patients. If patients do not know self-protection and self-management, catheter infection will be difficult to effectively control.

TCC infection is difficult to avoid, and the infection rate of TCC can be controlled by implementing quality index management, identifying the root cause of patient infection, continuously optimizing catheter nursing process, and training nurses and patients.

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