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Application Comparison of Different Tip Positions of Midline Catheters in Neurosurgical Patients

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Abstract: Objective To compare the clinical effect of midline catheter tip in different locations. Methods The 205 patients admitted to the neurosurgery department were divided into 105 patients in the catheter of the test group and 100 patients in the control group,the catheter tip of the test group located in the subclavian vein and the catheter tip of the control group in the axillary vein of the chest. Results There was no statistical difference in the catheter retention time and complications and the control group (P> 0.05). Conclusion The tip of the midline catheter is located in the subclavian vein and the axillary vein of the chest.

Keywords: Midline Catheter; Neurosurgical Patients; Complications; Indwelling Time

1. Introduction

Midline catheter (middle catheter, MC), also known as medium length catheter or medium length catheter, is a kind of upper limb expensive vein, head vein, median cubital vein and brachial vein inserted peripheral intravenous infusion tools, catheter tip can reach subclavian vein, puncture speed, high success rate, safety, low maintenance cost advantages, widely used in clinical[1], for severe patients provides an economic and safe intravenous infusion[2]. However, the optimal location and indwelling time of the MC tip are still controversial. The 2021 INS guideline[3] states that the MC tip should be retained at the axillary level for less than 2 weeks; 2021[4] recommends that the MC tip should be located in the axillary vein of the chest or the subclavian vein for months in the chest wall and[5] also recommends the MC tip in the thoracic axillary vein of the chest or the subclavian vein for 4 weeks. Neurologically severe patients[6] intermittent use of antibiotics, dehydrating agents, vasoactive drugs, electrolytes, intravenous nutrient solution and other irritating drugs to the blood vessels. The use of MC can reduce the stimulation of blood vessels by drugs and avoid the occurrence of potential complications[7]. A study[8] indicates that the MC tip is not positioned, which can cause multiple complications. By comparing the effects of different tip positions in neurosevere patients, this study can determine the location of the optimal tip, clarify its relationship with complications and indwelling time, and provide decision support for clinical placement nurses.

2. Materials and Methods

2.1 subject investigated

Patients admitted to the neurosurgery department,Inclusion criteria: (1) the expected time of intravenous infusion ≥1 week; (2) ≥14 years; (3) normal blood routine and coagulation function; (4) the patient or guardian approved the midline catheter and signed the informed consent; (5) the nature of the intravenous infusion met the indications of MC. Exclusion criteria: (1) infectious source at the catheterization site, history of thrombosis, trauma or vascular surgery; (2) combined immune system and hematopoietic dysfunction; (3) multiple organ damage, or severe dysfunction of other organs. The criteria were excluded (1) patients who were voluntarily discharged during catheter detention due to special conditions such as changes of condition; (2) patients who were transferred to hospital with tube. Computer generated random numbers were used into the test group (the catheter tip in the subclavian vein) and the control group (the catheter tip in the axillary vein of the chest).

2.2 Methods

In both groups, the supine position was taken and MC catheterization was performed in the ultrasound-guided modified Ceedinger technique in the optimal puncture region (ZIM), the middle of the upper arm. Evaluation the patient's skin and upper limbs before catheterization, explore the vessels in the upper arm ZIM area using an ultrasound system to strictly distinguish the arterial vein and avoid accidental

injury to the arteries. Test group: Measure the distance from the pre-puncture point to the subclavian vein, that is, the distance between the pre-puncture point along the vein to the ipsilateral thoracic clavicular joint minus 2cm is the catheter insertion length. Control group: measure the distance between the pre-puncture point and the axillary vein of the chest of the chest, that is, the distance between the pre-puncture point along the vein and the ipsilateral minus 3-4cm minus the length of the catheter.

2.3 Observing indicators

Catheter-related complications included Unplanned extubation, Catheter occlusion, Catheter dislodgement, Phlebitis, Catheter-related infection,Bleeding,Infiltration. The catheter is the days between the day of catheter placement and the day of extubation.

2.4 Quality control

All patients used a split three-way valve silicone catheter of the same brand and the same batch number, with a total length of 30cm. The catheter can be pruned spontaneously. All were performed by intravenous infusion specialist nurses with more than 3 years of experience in midline catheter catheterization. Unified training is also conducted to ensure the consistent catheter exposure length, catheterization and maintenance process. Unified trained researchers will collect relevant data and input the data into a dedicated electronic database.

2.5 Statistical methods

The data were analyzed and processed by SPSS26.0 software, count data were expressed by percentage and $\chi 2$ test; measurement data meeting the normal distribution were expressed by（±S）, and two independent sample t-test with $P < 0.05$.

3. Results

3.1General data between the two groups are compared,Table 1.

Table 1 Comparison of general data

item	experimental group（n=105)	control group（n=100）	statistical method	P-value
Age (year)	56.35±12.50	58.58±10.24	t=1.441	0.151
Gender（%）			$\chi 2$=0.1853	0.667
Male	64	58		
Female	41	42		
GCS	9.06±1.74	8.68±1.47	t=1.740	0.083
Disease type			$\chi 2$=2.744	0.254
Blood vessel of brain	57	44		
Brain trauma	22	30		
Brain tumor	17	16		
Others	9	10		
Position（%）			$\chi 2$=0.228	0.633
LUA	49	50		
RUA	56	50		
vein（%）			$\chi 2$=0.272	0.099
basilic vein	65	70		
brachial vein	45	30		

3.2 Comparison of catheter complications at different tip locations,Table 2.

Table 2 Comparison of catheter-related complications

item	experimental group（105）	control group（100）	$\chi 2$	P-value
Total complications	8	11	0.696	0.404
Unplanned extubation	2	3		

Catheter occlusion	1	2		
Catheter dislodgement	4	6		
Phlebitis	1	0		
Catheter-related infection	0	0		
Bleeding	0	0		
Infiltration	0	0		

3.3 Comparison of catheter indwelling time in the two patient groups,Table 3.

Table 3: Comparison of the indwelling time

item	indwelling time(d)	t	P-value
experimental group(105)	22.50±8.03	1.282	0.201
control group(100)	23.75±6.28		

4. Discussion

4.1The complication rate is low when the midline catheter tip is located in the subclavian vein

Zhao[9] suggested that the location of the MC tip in different veins may affect the safety of catheter use. According to Adams[10], the optimal position of the MC tip is the axillary vein and above. The results of this study showed that the overall incidence of catheter-related complications in the catheter tip was lower than with the catheter tip in the axillary vein. The blood flow rate of the head vein, the expensive vein or the axillary vein is 100 ~ 150 ml/min, while the blood flow rate of the axillary vein and the subclavian vein is 30 ml/min. The faster blood flow rate can quickly dilute the drug and reduce the stimulation of the vascular intima, thus reducing the incidence of chemical phlebitis and catheter-related thrombosis. Prasanna [11]suggested that patients with a catheter tip located in the axillary vein had a significantly higher incidence of catheter-associated thrombosis compared to the subclavian vein. Domestic scholars have found that the location of the MC tip above the axillary vein will significantly increase the risk of thrombosis[12,13], and the location of the midline catheter tip in the subclavian vein can reduce the incidence of catheter-related complications and prolong the indwelling time[14].

4.2The midline catheter was retained longer when the tip was located in the subclavian vein

Zhao[15]found that when the tip of the catheter was located in the subclavian vein, the rate of catheter-related complications was lower, the retention time was longer, and the clinical effect was better. During antimicrobial therapy with a midline catheter, the catheter tip was located in the subclavian vein, with a lower rate of catheter-related complications and a longer retention time of[16]. Catheter-related complications can affect the catheter use and indwelling time [17]. The results of this study showed that when the MC tip was in the subclavian vein, the catheter retention time was longer. Study[18] reported that the extubation rate of MC was 31.63% due to complications, and the main cause of extubation was catheter blockage. However, in this study, extubation was mainly due to unplanned extubation with consciousness disorder, suggesting that patients with consciousness disorder pay attention to restrain hands. When the MC tip is located in the subclavian vein, the catheter retention time can be prolonged by reducing the catheter-related complications.

5. Conclusion

There was no difference in the overall incidence and indwelling time when the MC tip was in the subclavian and axillary vein of the chests, and future studies could further explore the effect of MC retention time> 4 weeks on the incidence of catheter-related complications.

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