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Catheter Fracture of Intravenous Ports and its Management

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Abstract

Background Intravenous ports are widely used for oncology patients. However, catheter fractures may lead to the need for re-intervention. We aimed to identify the risk factors associated with catheter fractures.

Methods Between January 1 and December 31, 2006, we retrospectively reviewed the clinical data and plain chest films of 1,505 patients implanted with an intravenous port at Chang Gung Memorial Hospital. Different vascular sites were compared using the chi-square or Fisher's exact test for categorical variables, and the *t* test was used for continuous variables with normal distribution; $P < 0.05$ was considered statistically significant.

Results There were 59 and 1,448 procedures in the fracture and non-fracture groups, respectively. Monovariate analysis revealed that the risk factors for catheter fracture were as follows: large angle ($P < 0.0001$), female gender ($P < 0.0008$), subclavian route ($P < 0.0001$), and port type Arrow French (Fr.) 8.1 ($P < 0.0001$). Because these risk factors showed no interaction effects, they were all considered independent risk factors. When all factors were considered together, all risk factors, except angle and age, retained their statistical significance.

Conclusions Most catheter fractures were caused by material weakness. If catheter fracture is confirmed, further intervention for port and catheter removal is recommended. Female gender, intravenous port implantation via the subclavian route, and the Arrow Fr. 8.1 port were found to be risk factors. Patients with these risk factors should be monitored closely to avoid catheter fractures.

Ching-Yang Wu and Jui-Ying Fu contributed equally to this article.

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Introduction

Devices for long-term central venous access facilitate the administration of cytotoxic drugs, antibiotics, blood products, fluid and parenteral nutrition, and the collection of blood samples in patients with cancer [1, 2]. Intravenous port systems have been designed with these therapeutic goals in mind in order to avoid repeated venipuncture. In 1982, Niederhuber et al. introduced a completely implantable intravenous port system for patients with cancer [3]. An intravenous port system allows a patient unrestricted mobility [4], and it is also easy to use in clinical settings. However, many catheter-related complications result, including fracture, migration, infection, malfunction, and deep vein thrombosis. Catheter fracture with a dislodged intravascular catheter may be associated with severe complications, including pulmonary embolism, cardiac perforation, and sepsis [5]. The Gooseneck nitinol snare was introduced in 1991 as one method of retrieving intravascular foreign bodies [5]. In the present study, the clinical data of patients with catheter fracture were collected and analyzed. We wanted to identify the risk factors for fracture so that complications that lead to catheter fracture can be avoided, eliminating the need for re-intervention.

Materials and methods

Patient selection

We retrospectively reviewed 1,505 patients implanted with an intravenous port between January 1, 2006, and December 31, 2006, at Chang Gung Memorial Hospital. These patients were followed until June 30, 2010. The inclusion critierion was reception of an intravenous port in the year 2006. Exclusion criteria included implantation of the intravenous port via the inferior vena cava (IVC) route and port removal after completion of chemotherapy during the study period. In addition, patients without complete medical records and postoperative chest plain films or those in whom the catheter had migrated, as revealed in the postoperative chest plain film, were also excluded. All implantation and re-intervention procedures were included and were classified into two groups, fracture ($n = 59$) and non-fracture ($n = 1{,}448$), in order to analyze the risk factors associated with catheter fracture. For living patients, the date of the last outpatient follow-up visit was considered the endpoint of the follow-up. For the rest of the patients, the date of death or discharge against medical advice was considered the endpoint.

Devices and their use

An intravenous port had been implanted in our patients for single-lumen access. Four different types of port were used: Arrow Fr.8 (Arrow International Inc., Reading, PA), Bard Fr. 8, Bard Fr. 6.6 (Bard Access System Inc., Salt Lake City, UT), and Tyco Fr. 6 (Tyco Healthcare Group, North Haven, CT). We preferred the superior vena cava (SVC) route via the right cephalic vein or internal jugular vein approach because the catheter to be implanted was short. We used the vessel on the left side only under specific clinical conditions, for example, in patients in whom a right side intravenous port had been removed in the past or if the patient had undergone right modified radical mastectomy.

Implantation method

We applied the "cut down" method for catheterization of the right side cephalic vein. Subclavian or jugular punctures were used only when cephalic veins not available. After venostomy was completed, we ligated the distal end of the vessel and inserted the catheter via the venostomy into the SVC. If we experienced difficulties during blunt catheter implantation, a guidewire was used to establish an appropriate catheter route prior to catheter implantation. The catheter could slide over the wire to the correct position under intraoperative fluoroscopic guidance, and the guidewire could be removed after catheter implantation. If the diameter of the vessel was too small for catheter insertion, the modified Seldinger technique, which has been described by Coit and Turnbull, was used to increase the success rate of the "cut down" approach [6].

Follow-up and surveillance

We performed the percutaneous withdrawal test to examine the functioning of the intravenous port. Confirmation that the anatomical position of the catheter tip was correct was obtained by examining plain chest films (posteroanterior view). The position of the catheter was considered ideal if it was at the junction of the SVC and right atrium (RA). Plain chest films were obtained after the intravenous port was implanted and the angle between the locking nut and catheter was measured. We used the measurement function of the Physics and Astronomy Classification Scheme (PACS) system (GE, Fairfield, CT) to record the degree of the angle. The angle between the locking nut and catheter was defined as illustrated in Fig. 1. The A-line was drawn vertical to the midline of the locking nut, and the B-line was drawn at a tangent to the catheter.

Statistical analysis

Different vascular sites were compared with the chi-square or Fisher's exact test for categorical variables. The t test was used for continuous variables with normal distribution,

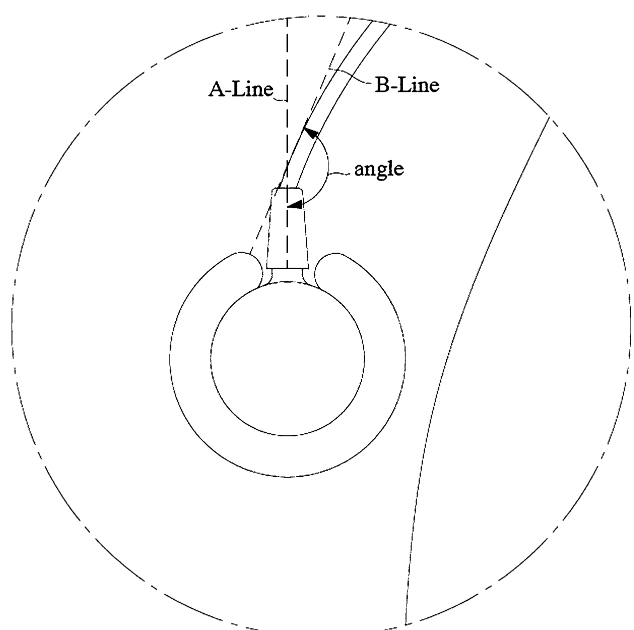

Fig. 1 Definition of the angle between the locking nut and catheter. *A-Line* vertical midline of the locking nut. *B-Line* tangent direction of the catheter

and P values <0.05 were considered statistically significant. All the analyses were performed with SAS, version 9 (SAS Institute, Cary, NC).

Results

Fifty-nine patients identified as having catheter fracture had reinterventions (Table 1). The mean age of these patients was 54.32 years. Only three types of ports had been implanted in these patients; the Arrow Fr. 8.1 intravenous port had been implanted in the majority (51/59, 86.4%) of these patients (Table 2). The fractures in nearly all patients (50/51, 98 %) with a fractured Arrow Fr. 8.1 intravenous port occurred at the locking nut area. In only 1 patient (2 %) with an Arrow port, the catheter had a perforation near the locking nut area. The 8 other patients with catheter fracture had either the Bard Fr. 6.6 or Fr. 8 implanted. In 3 of these, the fracture was detected at the proximal end of the catheter. In 2 patients, the fracture occurred at the locking nut area. In 3 other patients, the catheter had a perforation at the proximal end, near the locking nut. The entry site of the vessel was divided into two categories: the subclavian route and the non-subclavian route. The non-subclavian route included the internal jugular vein and cephalic vein. Twenty-nine patients (29/59, 49.15%) with catheter fracture underwent intravenous port implantation via the subclavian route. The operational findings at the fracture site were divided into three different areas: fracture at the locking nut area, fracture at the juxta-locking area, and perforation (Table 3). The fracture site was located at the locking nut area in 52 patients (52/59, 88.2%). With the exception of 1 patient who had a Bard Fr. 8 port, all of these patients had an Arrow Fr. 8.1 port. The mean angle between the locking nut and catheter was 163.3 degrees. The intervention-free period in this group of patients was 496.03 ± 321.41 days (Table 1). The majority of patients with

Table 1 Patients with and without catheter fracture

	Non-fracture group	Fracture group	P Value
Number of patients	1,448	59	
Gender			0.0008
Male	835 (57.67 %)	21 (35.59%)	
Female	613 (42.33%)	38 (64.31%)	
Age, years			0.85
Mean	57.15 ± 13.39	54.32 ± 13.11	
Range	8 ∼ 94	19 ∼ 77	
Port type			<0.0001
Arrow Fr. 8.1	373 (25.76%)	51 (86.44%)	
Bard Fr. 8	661 (45.65%)	5 (8.47%)	
Bard Fr. 6.6	403 (27.83%)	3 (5.08%)	
Tyco Fr. 6	11 (0.76%)	0	
Entry vessel			<0.0001
Subclavian route			
Right subclavian vein	168 (11.6%)	26 (44.07%)	
Left subclavian vein	36 (2.49%)	3 (5.08%)	
Non-subclavian route			
Right internal jugular vein	47 (3.25%)	1 (1.69%)	
Right cephalic vein	1,036 (71.55%)	22 (37.29%)	
Right other vessel[a]	9 (0.62%)	0	
Left internal jugular vein	15 (1.04%)	0	
Left cephalic vein	135 (9.32%)	7 (11.86%)	
Left other vessel[a]	2 (0.14%)	0	
Period of functional port			
Mean	406.57 ± 405.73	496.03 ± 321.41	0.04
Range	1 ∼ 1996	1 ∼ 1642	
Angle between locking nut and catheter			<0.0001
Mean	150.44[b] ± 28.04	163.3 ± 17.59	
Range	30.3 ∼ 180	89.2 ∼ 180	

Fr French

[a] Other vessel means entry sites other than the internal jugular vein and cephalic vein

[b] Seven patients were excluded because no plain chest film was available after intravenous port implantation

Table 2 Characteristics of fractured intravenous ports

	Arrow Fr. 8.1	Bard Fr. 8	Bard Fr. 6.6
Number of patients	51	5	3
Fracture site			
Subclavian route			
Locking nut area	25 (49.01%)	1 (20%)	0
Proximal end of catheter	0	1 (20%)	1 (33.3%)
Perforation only	0	1 (20%)	0
Non-subclavian route			
Locking nut area	25 (49.01%)	0	1 (33.3%)
Proximal end of catheter	0	1 (20%)	0
Perforation only	1 (1.96%)	1 (20%)	1 (33.3%)

fractured catheters remained asymptomatic until regular plain chest films were obtained. In 29 patients, the port had been implanted via the subclavian route; in the other patients, implantation was via a non-subclavian route (Table 2). Malfunction of the catheter was noted in 9 patients prior to confirmation of catheter fracture (Table 3). Infection was found in only 1 patient prior to catheter fracture. A fractured catheter without dislodgement to the deep intravascular space was detected in 7 patients (7/59, 11.9%). In 39 patients (39/59, 66.1%), the catheter was found to be dislodged to the RA or inferior vena cava. In addition, in 13 (13/59, 22%) patients, the catheter dislodged to a deeper site, including the right ventricle and pulmonary artery. All patients with a fractured catheter underwent reintervention, i.e., port removal or revision. The port was removed in all patients (58/59, 98.3%), except 1 in whom the catheter was shortened. The fractured catheters were smoothly removed via the femoral vein, using an intravenous snare or stone basket.

There were 1,448 patients in the non-fracture group, including patients who underwent no interventions and those with complications other than catheter fracture (Table 1). The mean age of these patients was 57.15 years. Four different types of intravenous ports had been implanted in these patients: Arrow Fr. 8, Bard Fr. 8, Bard Fr. 6.6, and Tyco Fr. 6. The entry site of the vessel was divided into the subclavian and non-subclavian routes, as mentioned previously. The mean angle between the locking nut and catheter was 150.44 degrees. The intervention-free period in this group of patients was 406.57 $\pm$ 405.73 days.

Possible risk factors were analyzed and are presented in Table 4. Patients with catheter fracture had a large angle between the locking nut and the catheter ($P < 0.0001$). Furthermore, female patients who underwent intravenous port implantation were at risk for catheter fracture ($P < 0.0008$). In addition, the Arrow Fr. 8.1 intravenous port accounted for significantly more catheter fractures ($P < 0.0001$). Further, implantation of the intravenous port via the subclavian route was found to result in more catheter fractures ($P < 0.0001$). However, the patient's age had no association with the incidence of catheter fractures. The period of functional port in the non-fracture group and the fracture group was the period between the operation and the last follow-up date and between the operation date and the identification of catheter fracture, respectively. The functional period of the intravenous port in the non-fracture group was shorter than in the fracture group ($P = 0.04$).

All identified risk factors were further analyzed with multiple logistic regression, and the results are presented in Table 5. We excluded patients who had received the Tyco intravenous port because of the small sample size. Thus we only analyzed whether the Arrow Fr. 8.1 port, Bard Fr. 8 port, and Bard Fr. 6.6 port were associated with catheter fracture. Multivariate logistic regression revealed that only port-A type Arrow Fr. 8.1, subclavian route, and female gender are significantly associated with catheter fracture (Table 5). However, based on the results of multivariate analysis, the angle was not related to catheter fracture ($P = 0.4$).

Discussion

Intravenous ports have the advantage of not requiring an external dressing, thus allowing the patient greater mobility. Further, they require only monthly maintenance (flushing) and are associated with fewer infectious complications than tunneled catheters [7]. Because catheters are widely used in clinical practice, many catheter-related complications have been noted and have become a challenge for physicians and surgeons. Catheter fractures resulting from a dislodged intravascular catheter may be associated with severe complications, including pulmonary embolism, cardiac perforation, and sepsis [5]. The reported mortality rate ranges from 23.7 to 60% [8]. The reported causes of death include septic endocarditis, arrhythmias with cardiac failure, thrombosis of the vena cava leading to pulmonary embolism, cardiac wall necrosis, and sepsis [9].

Table 3 Characteristics of patients with catheter fracture and management

	Male	Female	Total
Number of patients	21 (35.6%)	38 (64.4%)	59
Fracture site			
Subclavian route			
Locking nut area	10 (16.9%)	16 (27.2%)	26 (44.1%)
Proximal end of catheter	0	2 (3.4%)	2 (3.4%)
Perforated hole only	1 (1.7%)	0	1 (1.7%)
Non-subclavian route			
Locking nut area	7 (11.9%)	19 (32.2%)	26 (44.1%)
Proximal end of catheter	1 (1.7%)	0	1 (1.7%)
Perforation only	2 (3.4%)	1 (1.7%)	3 (5.1%)
Angle between locking nut and catheter			
Subclavian route			
Mean	170.37 4.77	$166.33^{a} \pm 15.22$	167.92 ± 12.16
Range	172.7 ~ 180	117.8 ~ 180	117.8 ~ 180
Non-subclavian route			
Mean	$152.54^{b} \pm 27.81$	$160.75^{c} \pm 17.75$	158.12 ± 21.24
Range	89.2 ~ 173.5	106.5 ~ 179.5	89.2 ~ 179.5
Total			
Mean	162.86 ± 19.89	163.54 ± 16.48	163.3 ± 17.59
Range	89.2 ~ 180	106.5 ~ 180	89.2 ~ 180
Clinical presentation			
Subclavian route			
Fracture only	8 (13.6%)	17 (28.8%)	25 (42.4%)
Fracture and infection	0	1 (1.7%)	1 (1.7%)
Fracture and malfunction	3 (5.1%)	0	3 (5.1%)
Non-subclavian route			
Fracture only	7 (11.8%)	17 (28.9%)	24 (40.7%)
Fracture and infection	0	0	0
Fracture and malfunction	3 (5.1%)	3 (5.1%)	6 (10.2%)
Location of dislodged catheter			
No dislodged catheter	3 (5.1%)	4 (6.8%)	7 (11.9%)
Right atrium	4 (6.8%)	15 (25.4%)	19 (32.2%)
Inferior vena cava	7 (11.9%)	13 (22%)	20 (33.9%)
Right ventricle	7 (11.9%)	5 (8.4%)	12 (20.3%)
Pulmonary artery	0	1 (1.7%)	1 (1.7%)
Management			
Remove port	7 (11.9%)	14 (23.7%)	21 (35.6%)
Remove port/catheter	5 (8.5%)	12 (20.3%)	17 (28.8%)
Remove previous port/change a new port	8 (13.6%)	12 (20.3%)	20 (33.9%)
Catheter shortening	1 (1.7%)	0	1 (1.7%)

[a] One patient was excluded from the analysis because no plain chest film was available

[b] Two patients were excluded from the analysis because no plain chest films were available

[c] Three patients were excluded because no plain chest film surveillance was available after intravenous port implantation

However, Fisher and Ferreyro reported 16 catheter-related deaths, 16 non-fatal complications related to embolized catheters, and 43 survivors without complications [10]. They concluded that the mortality and morbidity related to intravascular foreign bodies depend on the duration and location as well as on the material of the foreign body [10]. In our study, only one patient underwent catheter shortening because a fractured catheter remained in an adjacent area of soft tissue. We performed catheter shortening and reconnected the catheter to the port in order to restore its function. Other patients underwent port and catheter removal because of fractured catheters. Because of the fractured catheter removal, no intravascular foreign body remained and no further morbidity occurred.

A literature review revealed that the most common symptoms associated with catheter fractures include chest

Table 4 Descriptive statistics: independent variables for the fracture group and the non-fracture group

Variables	Fracture group	Non-fracture group	*P* Value
Age	54.32 ± 13.11	57.15 ± 13.39	0.85
Angle	163.30 ± 17.59	150.44 ± 28.04	<0.0001
Gender			0.0008
Female	38	613	
Male	21	835	
Port-A type			<0.0001
Arrow Fr. 8.1	51	373	
Bard Fr. 8	5	661	
Bard Fr. 6.6	3	403	
Tyco Fr. 6	0	11	
Subclavian group			<0.0001
Subclavian	29	204	
Non-subclavian	30	1,244	

Note: The *t*-test was used for age and angle; the chi-square test, for port-A type subclavian group and for gender

Table 5 Logistic models results

X(s)	β coefficient	Standard error	Odds ratio	95% confidence interval	*P* Value
Bard Fr. 6.6 versus Arrow Fr. 8.1	−1.53	0.69	0.03	(0.004–0.22)	0.03
Bard Fr. 8 versus Arrow Fr. 8.1	−0.46	0.46	0.09	(0.03–0.23)	0.32
Subclavian versus non-subclavian	0.58	0.15	3.18	(1.76–5.77)	0.0001
Angle	0.009	0.01	1.01	(0.99–1.03)	0.40
Age	−0.008	0.01	0.99	(0.97–1.01)	0.44
Gender (male/female)	−0.41	0.16	0.43	(0.24–0.80)	0.007

wall swelling at the injection port chamber and pain in the shoulder [11]. Other suggestive features include withdrawal occlusion, resistance to injection of fluid, sudden onset of cough or chest pain, palpitation, and a swishing sound during catheter irrigation. In our study, 83% of patients (49/59) were asymptomatic, and catheter fracture was detected during routine surveillance. The most common clinical presentation was catheter malfunction. In addition, pocket swelling and shoulder pain during irrigation developed in 2 patients. Only 1 patient had a coexisting infection. Therefore, a plain chest film is the first step in investigating intravenous port malfunction. Catheter tip malpositioning and catheter fracture with possible catheter embolism can be easily detected on a radiograph [12].

The location of a foreign body within the cardiovascular system depends on the route of entry and gravity, the stiffness of the material, the flow pattern of the vessel or cardiac chamber, and the position of the patient at the time of the accident [13]. Many patients were asymptomatic, probably because the site of the fragment was the right ventricle and pulmonary artery and there are few sensory endings in the endocardium and vascular endothelium [11]. In our study, intravascular foreign bodies were found in 88% of patients (52/59), and this finding is in agreement with the literature. In 66.1% of patients (39/59), we found fractured catheters in the RA and inferior vena cava because of the related straight route and gravity effect. Fractured catheters in the right ventricle (RV) and pulmonary artery were found in 22% patients (13/59). This may be related to the flow pattern in the vessel.

In our study, port type Arrow Fr. 8.1, female gender, and implantation of the intravenous port via the subclavian route were found to be related to catheter fracture (Table 5). The Arrow Fr. 8.1 intravenous port was associated with catheter fracture in this study. Catheter fractures occurred in 86.4% of patients (51/59) with Arrow Fr. 8.1 intravenous ports (Table 2). In 2 patients with Bard ports, the fracture site was at the locking nut area. In nearly all patients (50/51) with a fractured Arrow Fr. 8.1 intravenous port, catheter fracture occurred at the locking nut area. The catheter in 1 patient with an Arrow port had a perforation near the locking nut area. This finding may be related to the port's original design. The locking nut was made of metal and generates greater shearing forces than silicon tubes when it is pulled out completely. This may have led to material weakness caused by the locking nut.

Additional daily movement of the patient may have caused the linear-fractured catheter to slide out from the connecting part of the intravenous port, resulting in catheter dislodgement into the intravenous space.

Literature reviews have shown that catheter fracture is associated with percutaneous punctures of the subclavian vein because it is invariably located between the clavicle and the first rib. Aitken and Minton first described a so-called pinch-off sign, in which catheter pinch-off often precedes and may even predict the occurrence of a fracture [14]. Pinch-off signs present as intermittent dysfunction, and they mechanically compress the catheter [12]. In our study, 49.15% of patients with fractures (29/59) underwent intravenous port implantation via the subclavian vein. In contrast, 14.1% patients of the non-fracture group underwent intravenous port implantation via subclavian puncture. In multivariate analysis, intravenous port implantation via the subclavian route was found to confer greater risk for catheter fracture ($P = 0.0001$). This may be related to the pinch-off sign that Aitken and Minton first described. In our study, three different patterns of catheter fracture were also identified (Table 3). The majority of patients were found to have catheter fractures at the locking nut that were related to shearing force and caused by material weakness. However, there were 2 patients with perforations at the proximal end near the locking nut. Furthermore, there were 3 patients with a Bard intravenous port in whom the catheter fractured at its proximal end. The former failures may be related to the difference in rigidity between the locking nut and the catheter and the anatomical position. We implanted the port over the fascia of the pectoralis major because there was an alveolar plane between the subcutaneous adipose tissue and muscle. The corresponding position was higher than that of the cephalic vein, which is located in the deltopectoral groove (Fig. 2b, c). If the pocket created for port implantation is too small, the soft tissue overlying the pectoralis major can push the port upward, making it invisible on the plain chest film (Fig. 2a). Shearing forces can then lead to shortening of the distance between the locking nut and catheter. The lower lip of the locking nut would impinge on the catheter, making it more pliable. This would cause catheter perforation and further fracture. The latter may be related to the pinch-off syndrome that is associated with material weakness caused by repeat compression.

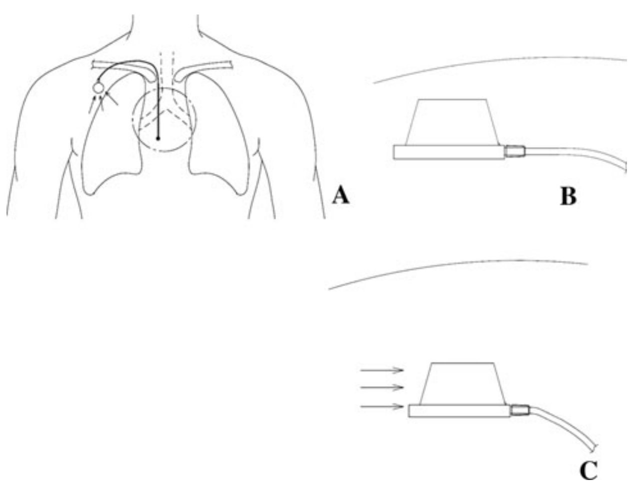

Fig. 2 Schematic illustration of the mechanisms of catheter perforation. **a** Intravenous port is pushed upward by abundant adipose tissue. **b** The status of the intravenous port without upward migration. **c** The status of upward migrated port may lead to impingement of the catheter by the injection chamber

Furthermore, female patients implanted with an intravenous port via the SVC were found to have a higher risk of catheter fracture. In our study, the majority (64.4%) of patients in the catheter fracture group were female. For female patients, the creation of an inadequate pocket may cause the intravenous port to be pushed upward by the breast and associated adipose tissue. This may cause impingement of the catheter on the locking nut, causing additional material weakening.

Our study revealed that the angle between the locking nut and the catheter was a statistically significant risk factor for catheter fracture ($P < 0.0001$). However, no such significance was found with multivariate analysis ($P = 0.4$). We hypothesize that there may have been additional contributory factors than the angle in the multiple logistic regression model, but it is difficult to answer this question through our retrospective study design. In addition, a shorter period of functional port in the non-fracture group was noted ($P = 0.04$). The period of functional port was related to the patient's underlying malignancy. Non-fracture group patients revealed more advanced disease.

In our study, the implantation of an intravenous port with a more rigid locking nut led to a higher risk of material weakness and catheter fracture. Creating an adequate subcutaneous pocket and smooth route are crucial to avoid catheter perforation and fracture. This is more important for female patients because they have more subcutaneous adipose tissue than male patients. Although the majority of patients with catheter fracture did not present with clinical symptoms, a plain chest film was necessary to survey the integrity of the intravenous port. In addition, pocket swelling after normal saline irrigation was highly suggestive of perforation even if the plain chest film was normal. If the fractured catheter moved into the intravascular space, further intervention for catheter removal was suggested by using either a gooseneck nitinol snare [5] or a stone basket [15].

The findings of our study led to some recommendations for the clinical practitioner. For surgeons, subclavian puncture should be avoided because of the high risk of catheter fracture. If a patient without a predominant cephalic vein and thoracoacrominal vein, the internal jugular vein is recommended as an entry vessel for the catheter. In addition, creation of an adequate pocket is crucial for port implantation, especially in female patients. Breast tissue may push the port upward, causing further impingement of the locking nut on the catheter. Prolonged catheter impingement results in material weakness of the catheter, and further fracture could be seen. Partial removal of subcutaneous adipose tissue and creation of an adequate pocket are recommended to reduce impingement. In addition, intravenous port with larger shearing force at the locking area is not recommended. For physicians, close port function monitoring and regular follow-up are recommended when patients with risk factors. (i.e., female patient, catheter entry via subclavian vein, Arrow port). If malfunction is identified, early re-intervention is recommended.

There are several limitations to our study. First, it is a retrospective study performed in a single center by surgeons. We employed both the vessel cut down and the puncture methods for intravenous port implantation, and our result might be different from the results obtained by radiologists. Second, there is no body mass index (BMI) data available. This study did not clarify the relationship between BMI and catheter facture. Because obesity and overweight have become more and more common in both Eastern and Western countries, further investigation of BMI is needed.

Conclusions

In the present study, the majority of catheter fractures were caused by material weakness related to the shearing forces exerted by the locking nut. Creation of an inadequate subcutaneous pocket may cause the port to move upward, thereby making it invisible on the plain chest film. This clinical scenario may further weaken the already weak material, leading to fracture and dislodgement of the intravascular catheter. To avoid catheter fracture, it is crucial to select an intravenous port with rigidity similar to that of the locking nut, and to create an adequately sized subcutaneous pocket. If catheter malfunctions are encountered during clinical use, a plain chest film is crucial to the integrity of surveillance of the intravenous port. If a catheter fracture is confirmed, further intervention for port and catheter removal is recommended. To date, no ideal artificial intravenous port has been developed. Further improvements in intravenous ports may lower the incidence of catheter fractures and reduce risks for patients.

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