



# Endovascular Removal of Foreign Bodies: Single Center Experience

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## Abstract

Catheter rupture or displacement is a serious and rare complication of central venous catheterization, with an incidence of approximately 1%. Once the intravascular foreign body is found, it should be removed as soon as possible. This study investigated the safety and efficacy of endovascular techniques for the removal of intravascular foreign bodies. This was a retrospective analysis of 23 patients with intravascular foreign bodies admitted to our hospital from January 2009 to June 2019 summarizing the types and locations of foreign bodies and the removal techniques. Overall Twenty-three cases of intravascular foreign bodies were successfully treated with endovascular techniques, for a technical success rate of 100%. The types of foreign bodies included 14 infusion port catheters (60.9%), 6 peripherally inserted central catheters (26.1%), 2 temporary deep vein catheters (8.7%), and 1 intravenous stent (4.3%). The most common orientation of foreign body displacement was one end of the foreign body in the inferior vena cava and the other end in the right atrium (14/23, 60.9%). In terms of technique, all patients underwent removal procedures with only one venous access point. The operative time ranged from 6 to 153 min, with an average of 28.7 min. This study preliminarily demonstrates the safety and efficacy of percutaneous interventional intravascular foreign body removal. Endovascular techniques are minimally invasive and reliable and can be used to safely and effectively remove intravascular foreign bodies.

**Keywords** Endovascular techniques · Foreign bodies · Removal

## Background

Central venous catheterization (CVC) is currently widely used clinically. Its main uses include chemotherapeutic drug infusion, parenteral nutrition support, and intravenous infusion in patients with poor peripheral vascular conditions. As the use of CVC increases annually, there are an increasing number of cases of rupture, shedding, and displacement. Catheter rupture or displacement is a serious and rare complication of CVC, with an incidence of approximately 1% [1]. However, in most cases, catheter rupture or displacement was asymptomatic and only found during routine catheter maintenance or chest fluoroscopy. In addition, a small number of patients would experience local swelling, endocarditis or even pulmonary embolism, cardiac perforation, cardiac arrest, etc.; thus, once the intravascular foreign body was found, it should be removed as soon as possible [2, 3]. This study investigated the

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safety and efficacy of endovascular techniques in the removal of intravascular foreign bodies.

## Patients and Methods

### Patients

This was a case series analysis which includes 23 patients with intravascular foreign bodies admitted to our hospital from January 2009 to June 2019. All the patients were included retrospectively according to historical patient records. The inclusion criteria were as follows: 1. all patients had complete medical records and preoperative imaging examinations; 2. the whole foreign body was located in the blood vessel; and 3. only an endovascular technique was used for removal. The exclusion criteria were as follows:

1. some part of the foreign body was found outside the blood vessel; and 2. any technique other than an endovascular technique was used for removal, such as open surgery.

### Methods

An Innova IGS 540 (GE, US) angiography machine was used as the guiding device. The puncture point was determined according to the position of the foreign body, and venous puncture was performed by the modified Seldinger's technique. The types of the catcher mainly included the clover-type catcher (En Snare, MERIT Medical, USA) and the gooseneck-type catcher (Günther Tulip, COOK Medical, Denmark). Angiography was performed after removal to confirm that there were no serious complications, such as rupture, perforation, or bleeding. Technical

**Table 1** Patients characteristics

Gender	Age	Medical History*	Indwelling time of catheters	Type of catheters**	Displaced location	Approach***	Type of catchers****	Operation time (min)
F	51	BC	3Y	IP	SVC-RA	RFV	ES	47
F	34	BC	3Y8mo	CVC	SVC-RA	RIJV	ES	54
F	53	BC	3Y	CVC	IVC-RA	RFV	ES	8
F	43	BC	3Y	IP	IVC-RA	RFV	ES	9
M	73	GC	3Y	IP	IVC-RA	RFV	ES	23
F	63	BC	3Y	IP	IVC-RA	RFV	ES	15
M	50	EC	1d	PICC	IVC-RA	RFV	ES	13
F	51	BC	3Y	IP	IVC-RA	RFV	ES	9
F	76	BC	5Y	IP	IVC-RA	RFV	ES	18
F	63	BC	2mo	IP	RA	RFV	ES	36
F	67	CC	4mo	PICC	IVC-RA	RFV	ES	10
F	43	OC	2d	PICC	IVC-RA	RFV	GT	20
F	46	BC	3Y	IP	RA	RFV	ES	30
F	47	BC	15d	IP	RA	RFV	ES	23
F	62	BC	4mo	IP	RA	RFV	ES	7
F	54	BC	4mo	PICC	SVC-RA	RFV	ES	11
F	38	BC	14mo	IP	IVC-RA	RFV	ES	6
F	54	BC	2mo	IP	IVC-RA	RFV	ES	19
F	50	BC	7d	IP	IVC-RA	RFV	ES	12
M	56	CC	2Y3mo	PICC	PA	RFV	GT	113
M	55	LC	6d	Venous stent	RA	RFV	GT	153
F	86	OC	4Y	PICC	IVC-RA	RFV	ES	16
F	56	BC	4Y	IP	IVC-RA	RFV	ES	9

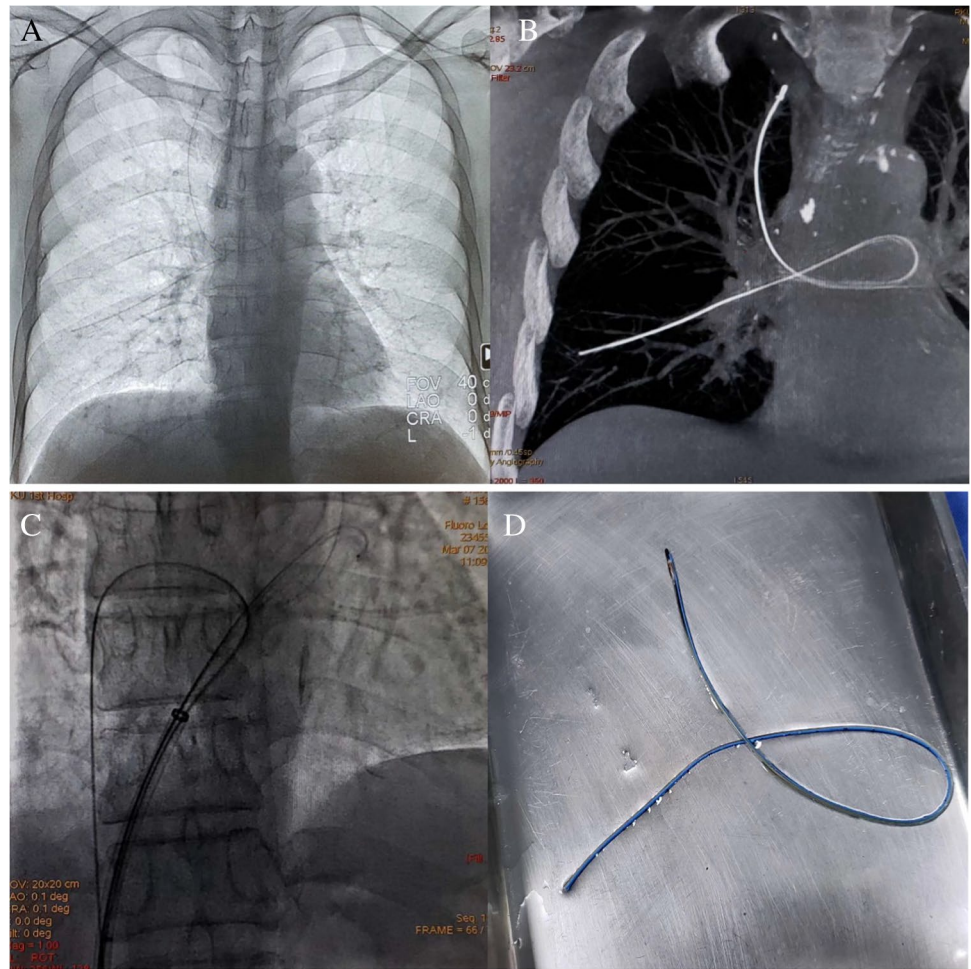
\* BC: Breast cancer; GC: Gastric cancer; EC: Esophageal cancer; CC: Colon cancer; LC: Lung Cancer; OC: Ovarian cancer

\*\* IP: Infusion Port; CVC: Central venous catheter

\*\*\* RFV: Right femoral vein; RIJV: Right internal jugular vein

\*\*\*\* GT: Günther Tulip; ES: En Snare

**Fig. 1** Gentleman, 56 y/o, colon cancer, peripherally inserted central catheter indwelled for 27 months. The patient showed hemoptysis for 2 weeks, and during the routine examination, catheter displacement was found. A-B: Chest X-ray and CT scan showed that both ends of the catheter were located in the branches of the pulmonary arteries, and the middle part of the catheter was twisted in the trunk of the pulmonary artery. C: View during the removal procedure. D: The removed catheter



success is defined as successful removal of the intravascular foreign body with no serious complications, such as hemorrhage or tissue damage, during or after surgery.

This study was approved by the Ethical Review Committee of Peking University First Hospital, Beijing, China (no. 2019研177). All patients signed informed consent forms before their removal procedures.

## Results

Twenty-three cases of intravascular foreign bodies were successfully treated with endovascular techniques. No serious complications occurred during or

after surgery. The technical success rate was 100%. All patient characteristics are shown in Table 1. The types of foreign bodies included 14 infusion port catheters (60.9%), 6 peripherally inserted central catheters (PICCs) (26.1%), 2 temporary deep vein catheters (8.7%), and 1 intravenous stent (4.3%). The most common orientation of foreign body displacement was one end of the foreign body in the inferior vena cava (IVC) and the other end in the right atrium (RA) (14/23, 60.9%); the second was the whole foreign body in the RA (5/23, 21.7%); the third was one end of the foreign body located in the superior vena cava (SVC) and the other end in the RA (3/23, 13%). In terms of technique, all patients underwent removal procedures with only one venous access point; 22 patients chose the right

**Fig. 2** Gentleman, 55 y/o. The superior vena cava was compressed due to lung cancer, and displacement of the venous stent occurred during the stent implantation procedure. A: The displaced stent (as the arrow pointed). B–C: The guide wire was wrapped around the stent, and then the free end of the guide wire was caught using the catcher. D: View during the removal procedure



femoral approach (22/23, 95.7%), and 1 patient chose the right internal jugular vein approach (1/23, 4.3%). Among all twenty-three catchers, twenty (20/23, 87%) were clover-type catchers (En Snare, MERIT Medical, USA), and the other three (3/23, 13%) were gooseneck-type catchers (Günther Tulip, COOK Medical, Denmark). The operative time ranged from 6 to 153 min, with an average of 28.7 min. In addition, among all procedures, five removal procedures were assisted by pigtail catheters; two procedures were completed by “guide wire assistance” and an “indirect capture technique,” which are detailed below.

## Discussion

The results show that endovascular techniques can be used to remove intravascular foreign bodies safely and effectively and that these techniques are

minimally invasive, reliable, easy to perform, and have low complication rates. With popularization and rapid development, intravascular techniques should be preferred for the removal of intravascular foreign bodies [4–6].

In recent years, with advancements in medical equipment and technology, the incidence of iatrogenic intravascular foreign bodies has gradually increased. In clinical work, we should avoid or reduce the fracture and ectopic placement of vascular implants as much as possible and detect intravascular foreign bodies in a timely manner [7]. The vast majority of intravascular foreign bodies removed in our center in the past decade were central venous catheters. By reviewing the medical history, we found that most patients underwent CVC because of the need for chemotherapy, which meant that the catheters would remain indwelling for a long time. According to our data, 56.5% (13/23) of the catheters remained indwelling for more than



12 months. In addition, some patients with longer catheter indwelling times lacked routine maintenance, which might increase the likelihood of catheter breakage or displacement [8]. Moreover, rupture might occur due to compression in the narrow space between the clavicle and the first rib, so-called clipping syndrome, which is more common in patients with infusion ports. In response to this situation, it has been suggested that the use of the jugular vein or subclavian vein approach could effectively prevent the occurrence of clipping syndrome. In terms of the displacement position, 60% of the foreign bodies were located in the RA, while the other end extended into the IVC. In this scenario, the foreign body could usually be removed by grasping the end in the IVC. Another 22% of foreign bodies were found in the RA, and these cases were prone to serious complications, such as arrhythmia, cardiac arrest, and even heart rupture during the removal procedure. Therefore, the removal process should be performed very carefully and meticulously. In terms of the operative time, the average time for all 23 procedures was 28.7 min. Among all procedures, two procedures lasted more than 100 min: in one case, a fractured PICC was displaced in a complicated position, with both ends of the catheter in the branches of the pulmonary arteries and the middle part of the catheter twisted in the trunk of the pulmonary artery (Fig. 1); in the other case, a metal stent was found in the RA, which had been displaced from the SVC (Fig. 2). These two removal procedures were difficult, and we tried to use the guide wire to wrap the foreign body and used the catcher to catch the free end of the guide wire to successfully remove the foreign body. A similar method has been previously reported [9, 10].

This study preliminarily demonstrates the safety and efficacy of percutaneous interventional intravascular foreign body removal. In short, endovascular techniques are minimally invasive and reliable and can be used to safely and effectively remove intravascular foreign bodies.

**Authors' Contributions** TS Lyu made substantial contributions to the conception and design of the study and drafting of the manuscript. SJ Cao made substantial contributions to the analysis and interpretation of data. L Song and J Wang substantially contributed to the data acquisition and analysis. XQ Tong revised the manuscript critically for important intellectual content and was involved in data acquisition and analysis. YH Zou was involved in the conception and design of the study, data interpretation and analysis, and revising the manuscript for intellectual content. All authors gave final approval of the version to be published. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of

any part of the work are appropriately investigated and resolved. All authors read and approved the final manuscript.

## Declarations

**Consent to Participate** For this type of study, formal consent is not required. Informed consent was obtained from all individual participants included in the study.

**Consent for Publication** Consent for publication was obtained for every person's data included in the study.

**Conflict of Interest** The authors declare that they have no conflict of interest.

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