

# Management of outpatient with totally implantable venous access Ports during the COVID-19 epidemic

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## Abstract

The purpose of this study was to explore the management experience of outpatient with totally implantable central venous access Ports (TIVAPs, Ports) during the epidemic, including whether the extension of the irrigation interval will affect the incidence of catheter occlusion, the reasons for the port removal rate, and the corresponding protective treatment strategies during the COVID-19 epidemic.

We retrospectively analyzed the Ports evaluation and flushing procedure data between February 3, 2020 and April 3, 2020; the cases were divided into the normal group and delayed group according to the critical point of the maintenance interval of 28 days (4 weeks). We compared the incidence of catheter obstruction between the 2 groups, analyzed the causes of catheter removal events in the 2 groups, and proposed corresponding protective treatment recommendations.

During the period, 329 cases were included in the study. There was no significant difference in the incidence of catheter obstruction between the 2 groups. There were 15 patients with catheter removal, 8 cases of infection, 5 cases of catheter obstruction, and 1 case of an ectopic catheter, as well as 1 case of an overturned port. During the epidemic, no hospital infections related to the Ports flushing procedure occurred.

The interval of Ports flushing procedures for patients without clinical symptoms can be appropriately extended during the COVID-19 epidemic. However, once the local infection symptoms or other sources of discomfort appear, Ports assessment needs to be performed as soon as possible. Take enhanced protected and isolation measures did not increase cross-infection during outpatient's flushing procedure at non-COVID-19-designated diagnosis and treatment hospitals.

**Abbreviations:** COVID-19 = 2019 coronavirus disease, TIVAPs = totally implantable venous access Ports.

**Keywords:** complications, 2019 coronavirus disease, flushing intervals, totally implantable venous access Ports, unplanned surgery

## 1. Introduction

Since December 2019, a new type of coronavirus infection, known as the 2019 coronavirus disease (COVID-19), has erupted all over the world.<sup>[1]</sup> To avoid infection, most non-emergency

patients choose to stay at home, rather than going to the hospital. This decision objectively prolongs the interval of the flushing procedure of totally implantable venous access ports (TIVAPs) for most patients, which may increase the related complications, even unplanned device removal.<sup>[2]</sup> Regular flushing and locking between treatment intervals are considered to be the important interventions for maintaining catheter patency, and they are aimed at preventing catheter blockage and minimizing the risk of infection.<sup>[3]</sup> There is no consensus about the optimal flushing interval to for the flushing and locking procedure in outpatient care.<sup>[4–6]</sup> In our daily work, we followed the recommendation of the outpatient's flushing procedure interval of 4 weeks.

As our hospital is a designated cancer diagnosis and treatment hospital for uninfected COVID-19 patients in Wuhan, we conducted the outpatient's Ports flushing procedure work during the COVID-19 epidemic; we found some problems and complications that should be highlighted. In this article, we aimed to evaluate the outcomes of the Ports flushing procedure, complications and management strategies and to present our experiences during the virus epidemic period.

## 2. Methods

### 2.1. Study design and sample collection

A retrospective observational study was conducted from February 1, 2020 to April 3, 2020, at the radiology outpatient clinics of the Hubei Cancer Hospital in Wuhan, China. Patients

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WY and CZ contributed equally to this work.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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who came to the hospital for the flushing and locking procedure during the entire study period were included in this study sample. The main exclusion criteria were having incomplete previous Ports flushing records, an ECOG score above 2, and inability to self-protect and cooperate. This study was approved by the Institutional Review Board of Hubei Cancer Hospital, China.

**2.2. Measures to prevent infection**

During the epidemic, outpatients should made online appointments before they came to the hospital to incline the risk of cross-infection. All personnel visiting the maintenance center must wear masks and should be screened for body temperature and symptoms. An immediate body temperature value over 37°C or clinical symptoms, such as chills, coughing, and difficulty breathing, indicate suspected COVID-19 infection. The suspected patients and accompanying individuals were immediately quarantined and transferred to a Wuhan COVID-19-designated admission hospital for confirmation and treatment.

The triage physicians who perform fever and clinical symptoms screening take self-protection measures according to the level II protection standards. Medical goggles or face masks are worn when necessary. Other staff at the center adopt the level I medical protection standards for self-protection.

**2.3. Ports flushing procedure**

Ports flushing procedure performed by professionally trained and experienced physicians in a separate ventilated and fully disinfected room. We should evaluated the local skin of reservoir bag for signs of redness, swelling and pain before washing procedures. When above-mentioned signs happened, the local anti-infective treatment or even to remove device should be took as soon as quickly.

All procedures were conducted using standard aseptic precautions. A manual injection of 10 ml of 50 ml/L heparinized saline was performed using “push-pause” technique, and a positive pressure for lock of catheter. We used povidone-iodine in alcohol solution for skin washing to minimize the risk of infection.

**2.4. Incident collection statistical analysis**

Patients were divided into 2 groups: the normal interval group (intervals within 4 weeks) and the delayed interval group (intervals of more than 4 weeks). The incidents of catheter occlusion were collected and categorized into the normal interval group and delayed interval group to compare the patency of catheter between the 2 groups.

To compare the occurrence of catheter occlusion in the 2 groups of patients, the c2 test was used. Significance was set at  $P < .05$ . Statistical analysis was performed using SPSS Software, version 23. Unplanned removal or reposition of TIVAPs and other complications were calculated as raw numbers and percentages.

**3. Result**

From February 1, 2020 to April 3, 2020, a total of 329 patients underwent 427 port care and flushing procedures at radiology outpatient clinics. Eleven patients were excluded in the analysis of catheter obstruction (Fig. 1). Seventy seven patients were

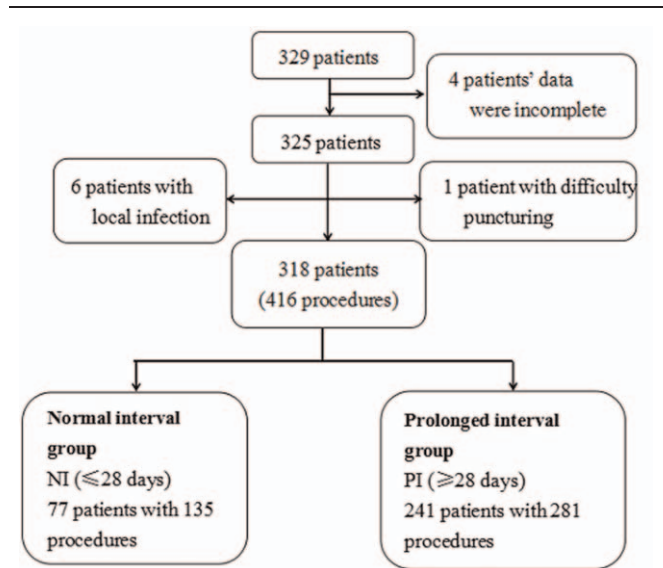


Figure 1. Patient enrolls and group.

included in the normal group, and 241 patients were included in the delayed group. None of the patients' characteristics between 2 groups reached significant differences (Table 1). We found 19 patients who presented catheter occlusion in the delayed group compared with 3 in the normal group. There was no significant difference in the incidence of catheter occlusion between the normal group and the delayed group (Table 2).

Thirteen patients received unplanned removal or repositioning surgery due to catheter dysfunction or complications. The reasons for the removal and repositioning surgery of TIVAPs are summarized in Table 3.

No procedure-related mortality or COVID-19 virus infection was observed in any patients during the period.

**4. Discussion**

COVID-19 is a coronavirus that can be transmitted from person to person,<sup>[7]</sup> and it was first isolated from a bronchoalveolar lavage sample,<sup>[8]</sup> which indicates that the main transmitted approach was via droplets similar to other respiratory viruses. In addition, the virus RNA is also detected in pharyngeal swabs, as well as stool, saliva urine, and blood,<sup>[9,10]</sup> which indicates that the fecal-to-oral route may be possible, but little evidence supports it. Some studies have shown that COVID-19 virus can survive on various surfaces, such as plastic, glass, stainless steel, and cardboard, for several hours.<sup>[11,12]</sup> This persistence indicates that

**Table 1**  
Patient characteristics.

	Normal interval group (≤28 days), n=77	Delayed interval group (>28 days), n=241	P
Sex			
Male, n(%)	11 (14.3%)	48 (19.9%)	.268
Female, n(%)	66 (85.7%)	193 (80.1%)	
Age (years), mean(SD)	53.1 (11.2)	54.4 (10.7)	.384

**Table 2**  
**Patient catheter occlusions.**

	Normal interval group (≤28 days), n=77	Delayed interval group (>28 days), n=241	P
Catheter occlusions	3 (3.9%)	19 (7.9%)	.230
Permanent occlusion	0 (0%)	5 (2.49%)	.455

virus transmission through contacting contaminated surfaces might be possible.

The clinical features of the majority of patients are fever and respiratory symptoms 3 to 7 days after COVID-19 virus infection, whereas nasal symptoms, sore throat, and myalgia are rare.<sup>[13]</sup> In addition, early statistics show that approximately 15% of infected patients may develop severe pneumonia, and approximately 6% develop respiratory failure or multiple organ failure.<sup>[14]</sup> Considering that cancer patients have poor immunity and poor body resistance for virus infection, we monitored the body temperature and respiratory symptoms before they entered the outpatient hall. Anyone suspected of being infected with COVID-19 was immediately quarantined, accompanied and transferred to a COVID-19-designated hospital.

We also adopted several measures to prevent cross-infection at the TIVAPs Maintenance Center as follows: Outpatients should take online appointments before them come to the hospital according appointments time periods, requiring personnel to wear masks, avoid conversations and maintain a distance of more than 1 m among them; restricting the entry of patients for the Ports flushing and locking procedure to 1 at a time; taking strict hand hygiene measures before contacting the patient and after the aseptic operation; setting up clean areas, buffer zones, and contaminated areas in the center and disinfecting daily, while the operating room underwent UV disinfection for 20 minutes every 4 hours; and recycling and disinfecting contaminated medical dressings and puncture needles. Through the implementation of the above measures, our center did not have any cross-infection with COVID-19 between medical staff and patients and their families during the period.

Although most patients who came to the center for port maintenance during the COVID-19 outbreak had problems when the maintenance intervals were prolonged, our retrospective analysis found no significant difference in catheter obstruction rates between the normal group and the delayed group. These findings are consistent with previous reports, despite the selected cut-off value for the mean frequency of flushing being different from that used in previous studies.<sup>[4,5,15]</sup> The current clinical guidelines recommend maintaining catheter patency through flushing and locking devices at regular intervals based on the

**Table 3**  
**Causes of TIVAD-related removal or repositioning.**

Causes	Number, n (%)
Infections	
Local infections	6 (1.85%)
CRBSI	2 (0.61%)
Permanent occlusions	5 (1.54%)
Catheter malposition	1 (0.31%)
Overturned port	1 (0.31%)
Total unplanned surgery	15 (4.62%)

theoretical assumption that catheter obstruction could occur due to the accumulation of biological and exogenous material, which could contribute to device dysfunction.<sup>[16,17]</sup> However, the causes of catheter occlusion were multifactorial in vivo.<sup>[18-21]</sup> We believe that the proper extension of TIVAPs maintenance intervals during the outbreak did not increase the risk of catheter obstruction. However, whether the catheter recanalization rate after thrombolytic therapy was related to the delayed port flushing interval warrants further study. Our data showed 5 patients in the delayed group who still presented with catheter occlusion after thrombolysis treatment, resulting in catheter removal.

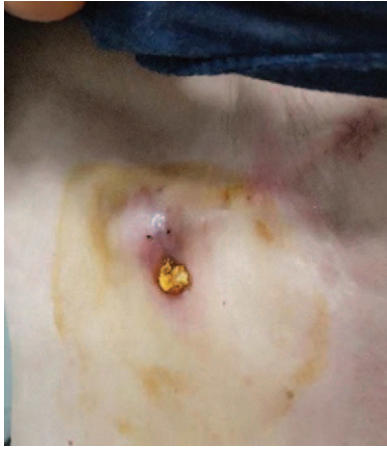
During the 2-month study period, we performed 14 cases of port removal and 1 case of port repositioning surgery, accounting for 4.56% of the 329 sample cases. Previous long-term observations studies had reported that the complication-related removal rate accounted or between 1% and 8.3%.<sup>[15,22,23]</sup> The reasons for removal or repositioning of TIVAPs are summarized in Table 3.

Infections are one of the most frequent reasons of unplanned removal operation, which adversely affects mortality and is associated with increased healthcare costs. The treatment usually includes the removal of the device and a systemic antimicrobial therapy.<sup>[24]</sup> Only under certain circumstances (the expected risk of device removal or difficulty in replanting) can salvaging the device be taken into consideration.<sup>[25]</sup> Obviously, in case of a local infection (tunnel infection or a pocket infection), the port is usually removed promptly. The time between the need to remove the port and its actual removal is a variable significantly associated with the occurrence of complications.<sup>[26]</sup>

We encountered local infections in 6 patients in the delayed group. Among these patients, 4 presented with local incision infections in the first follow-up after implantation; this may be due to the lack of regular and strict aseptic disinfection of the incision after the implant surgery. The lack of timely treatment when local swelling and pain symptoms appeared was another



**Figure 2.** showed that the skin necrosis and defection at incision which due to infected, exuding purulent fluid, after Ports surgery. He did not come to the hospital for treatment timely when the incision cite had been infected. Subsequently, the skin in the port area gradually became necrotic and developed a skin defect, which necessitated port removal at 45 days after implantation.



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factor (Fig. 2), which ultimately led to the device being removed due to necrosis and defects at Ports site skin (Fig. 3). The other 2 patients with local infections showed damage to the local skin at the reservoir position; they reported that the initial symptoms manifested as redness and swelling at the implantation site, and the area of redness gradually developed into skin ulcers within several days. In addition, we encountered 2 cases confirmed as catheter-related bloodstream infections (CRBSI). Finally, we chose to remove the device in 2 patients, considering the increased costs with antibiotic treatment.

Catheter dysfunction is another frequent reason for Ports-related unplanned removal surgery. Many causes contribute to catheter dysfunction, such as catheter occlusion and thrombosis, overturned port reservoirs, disconnected catheter reservoirs, catheter migration, and even pinch-off syndrome. Catheter dysfunction caused by intraluminal catheter thrombosis can use thrombolytic treatment empirically as the first therapeutic option. When the thrombolytic therapy fails and manifests as permanent dysfunction, the device should be removed. In our observation, 5 cases in the delayed group still showed catheter occlusion after catheter thrombolysis treatment, and they ultimately underwent port removal surgery.

Furthermore, we found 2 patients with rare complications confirmed by X-ray fluoroscopy who received device removal: 1 case with catheter migration and another with an overturned port reservoir. Such complications may be asymptomatic. Overturned port reservoirs may be due to technical problems during the device insertion. To prevent such problems, the catheter-reservoir connection should be carefully checked while inserting the device.<sup>[27]</sup> Catheter migration usually develops due to mechanical stresses, such as a transient increase in thoracic pressure. The catheter displacement cases (Fig. 4) in this study presented with nausea and vomiting in the recent flushing interval. Then, we found a crease in the catheter that was surgically removed, indicating a discount injury caused by catheter displacement (Fig. 5).

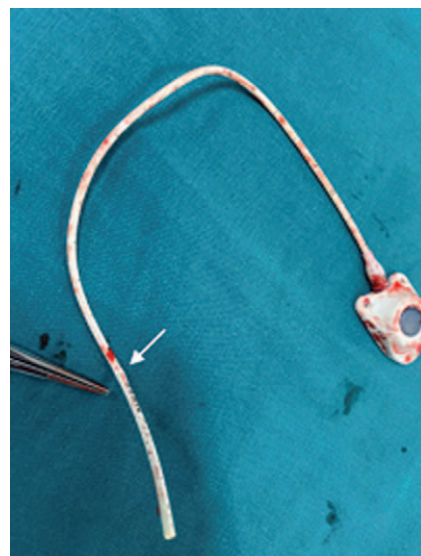
This study was a cross-sectional observational statistical analysis in study design, and it had the following limitations:



**Figure 4.** showed catheter displacement leading to catheter discounts. Preoperative X-rays show signs of catheter discounts (black arrows), which were confirmed upon catheter removal after surgery (white arrows).

many factors influence the complications, and they were included in the analysis; many asymptomatic patients were not included in the data during the epidemic, resulting in sample selection bias. In addition, the other conditions of patients who came to the hospital during the epidemic were not included in the analysis and discussion in this study. Such as the risk grade of infection in the patient's residential district, the patient's disease comorbidities (coronary heart disease, diabetes, pulmonary insufficiency etc.)

Despite these limitations, we still found some problems and characteristics through the retrospective analysis and provide some recommendations as follows: during the COVID-19



**Figure 5.** showed catheter displacement leading to catheter discounts. Preoperative X-rays show signs of catheter discounts (black arrows), which were confirmed upon catheter removal after surgery (white arrows).

epidemic, the interval between flushing procedures for patients without clinical symptoms can be appropriately extended; the patient should visit an outpatient clinic to assess ports as soon as possible when local infection symptoms or other discomfort appears to prevent the occurrence of serious complications that could lead to unplanned catheter removal; through enhanced outpatient COVID-19 infection screening and protective measures, the risk of cross-infection during the outpatient's flushing procedure is significantly reduced, especially in non-COVID-19-designated diagnosis and treatment hospitals.

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## Author contributions

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**Resources:** Chaoya Zhang, Zilin Li.

**Writing – original draft:** Chenggang Luo, Weipeng Yan.

**Writing – review & editing:** Weipeng Yan.

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