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Original Article

Regular Flush-lock is Unnecessary to Maintain Patency of Resting Totally Implantable Venous Access Device

ACW ***Lee***, ND ***Ong***

Abstract ***Objective:*** The manufacturer recommends totally implantable venous access devices (TIVAD) be flushed with a heparin solution every four weeks when they are not in use. However, there is no medical evidence to support this practice. We seek to examine if catheter patency can be maintained when regular flushing for TIVAD is omitted. ***Methods:*** From January 2010 to July 2017, patients whose TIVADs were accessed more than 56 days from the last use were identified. The patency of the catheters and interventions taken for catheter occlusion were noted. ***Results:*** 37 children with cancers/blood disorders and TIVADs had had 89 accessions during the study period. The mean age of the children at the time of access was 8.2 (range 1.7-18.0) years. The median interval from the last access was 126 (range 57-706) days. Backflow of blood from the TIVAD was not obtained on 6 patients/occasions (6.7%). Among them, the TIVAD was still usable in 5 patients. The device was considered redundant and removed in the other patient. ***Conclusions:*** The optimal frequency and perhaps necessity of routine maintenance flushing for TIVAD has yet to be determined. Omission of routine heparin saline flush-lock during prolonged periods of rest does not seem to compromise their patency.

Key words Central venous catheterization; Port-A-cath; Vascular access devices

Introduction

Central venous access devices such as totally implantable venous access devices (TIVADs) and exteriorised central venous catheters (CVCs) are commonly used in paediatric haematology and oncology patients for the facilitation of medical treatment by providing an always-ready venous access for prolonged period of use.[1] These are mostly silicon or polyurethane catheters with the proximal end inserted surgically into the central veins, most commonly the superior vena cava, through the subclavian vein or one of the jugular veins. The distal portion of the catheter then lies in a subcutaneous tunnel before connecting to the accession point. In TIVAD, the accession point is a metal port that is laid in the subcutaneous tissue of the chest wall. In CVC, the distal portion of the catheter exits from the skin (hence exteriorised) and is joined with the injection hub.

Ideally, all these venous devices meant for long-term use should be safe with minimal infectious and mechanical complications. Also, they should be easy to look after with minimal burden to the caretakers once the patients are discharged home. The choice between TIVAD and exteriorised CVC often depends on clinician's and patient's preference, and takes into consideration the ease of home care and rates of complications. In our practice, TIVAD is preferred as infectious complications generally occur less and no technical precautions are needed when the child goes home. Lebeaux et al,[2] from a systematic review, reported an infection rate of 0.2 per 1,000 catheter-days

Children's Haematology and Cancer Centre, Mount Elizabeth Hospital, Level 4, 3 Mount Elizabeth, Singapore 228510

ACW **Lee**(李志偉) *MBBS, FRCPCH*
ND **Ong**(王曉萍) *RN, ADP*

Correspondence to: Dr ACW **Lee**
Email: anselm.cw.lee@gmail.com

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among paediatric oncology patients, as compared to 1.4 to 1.9 per 1,000 catheter-days when CVCs are used.[3] A large single-institution study also reports the use of TIVAD among children with cancer is associated with the shortest length of stay, intensive care unit time and antibiotic therapy when compared with tunnelled CVCs and peripherally inserted central venous catheters.[4]

Both TIVAD and CVC require maintenance flush-lock at regular intervals when the venous devices are not in use. Exteriorised CVC has to be flushed and locked with heparin saline solution at least once a week and it is a common practice that children have to return to the hospital twice a week for catheter maintenance in between treatments. TIVAD needs to be flush-locked once every 4 weeks. As most chemotherapeutic regimens are scheduled every 21 to 28 days, this means that the patients can forget about the maintenance flushing of their devices in between treatments.

However, when TIVAD is left idle for more than four weeks, a maintenance flush-lock with heparin saline solution is commonly practised. This has to be done at specialised medical centres, using a non-boring needle. It becomes a nuisance and an added expense if the patient is staying far away or abroad from the medical centre. In young children, the sight of a needle going into their body may still be a traumatic event even when local anaesthetic cream has been applied. The practice of the 4-weekly flush-lock for maintenance of patency originates the manufacturer's recommendation.[5] However, the practice is not supported by medical evidence[6] and is unwelcome by the paediatric patients and their parents.[7] In a previous correspondence, we have briefly described our experience of omitting the routine flush-lock of TIVAD.[8] In the following report, we will expand our findings to support the notion that TIVAD patency can be safely preserved without the monthly puncture.

Materials and Methods

Children with TIVAD (Port-A-cath, Smith Medical, St. Paul, USA) who required venous access after an interval of more than 56 days from the last use formed the subjects of the study. The study period spanned from January 2010 to July 2017. The outcomes of the device accessions are described.

In our practice, only designated staffs are allowed to access or de-access the needle from the TIVAD. On de-accession, the device is first flushed with 5-10 mL of normal saline to clear any blood or medications, and is then locked with 50 units of heparin saline in 5 mL (B. Braun, Melsungen, Germany). The non-boring Gripper needle (Smith Medical, St. Paul, USA) is clamped at positive pressure prior to the end of the heparin saline flushing and the needle is then removed by the same operator.

Upon accession, an appropriate-sized Gripper needle, primed with a 10-mL syringe of normal saline, is used. If an initial attempt to withdraw venous blood from the TIVAD is not successful, a bolus of two to three milliliter of normal saline will be pushed in with gentle pressure. The normal saline flush may be repeated until venous blood can be obtained, or will be stopped if there is undue resistance to forward flow.

The TIVAD is considered patent if venous blood can be withdrawn and there is little or no resistance to forward flow. Otherwise, consideration will be given for the use of urokinase to restore patency or device removal if further central venous access is deemed unnecessary. In the former situation, urokinase (Yao Chih Hsiang, Tao Yuan, Taiwan), 9,000 units in 1.5 mL contained in a 10-mL syringe, is to be instilled into the TIVAD via the Gripper needle. If there is resistance to forward flow, a negative pressure is first created by suction with an empty 10-mL syringe. When the syringe of urokinase is connected, a portion of the drug is automatically sucked into the TIVAD. With further gentle pushes and pulls, the dose of urokinase will be further distributed into the device. The urokinase is then locked under positive pressure for at least two hours, after which attempts to withdraw blood from the TIVAD will be made again.

Results

Based on an in-house protocol, regular flush-lock of TIVAD has been purposely omitted no matter how long it is not used. During the study period, 37 children of mean age of 8.2 (range 1.7-18.0) years at the time of access were identified. The underlying diagnosis included leukaemia (n=16), neuroblastoma (n=11), lymphoma (n=3), and others (n=7). A total of 89 device accessions were recorded. The median interval after the last use was 126 (range 57-706) days. The reasons that the TIVADs were used again included contrast injection with or without sedation for imaging (n=48), intravenous sedation for bone marrow aspiration (n=21), emergency treatment for febrile illnesses

or dehydration (n=11), treatment of disease recurrence (n=8), and blood sampling (n=1).

Of the 89 attempts of access, the TIVAD was noted to be patent on 83 occasions (93%). Catheter occlusion occurred at a rate of 0.39 per 1,000 patient-days. On six occasions, venous blood could not be obtained (Table 1). In four children, urokinase was instilled into the device as an attempt to restore patency. In one child, the forward flow was fine and the TIVAD could be used without urokinase treatment. In the other case, the venous device was deemed no longer needed and it was removed without thrombolytic treatment. After urokinase treatment, device patency was restored in two patients completely. In the other two cases, patency was restored partially and the TIVADs were usable for intravenous therapy and transfusion. None of the children had any signs of catheter-associated infections or complications when their TIVADs were not in use during the prolonged periods of rest.

Discussion

Central venous access devices are an essential component in the modern management of childhood cancers, complex haematological diseases, and haematopoietic stem cell transplantation.[9] Surgical aspects with respect to how the devices should be inserted or removed,[1,10] and medical aspects looking into the management and prevention of infectious and thrombotic complications have been well studied.[11] However, the nursing aspects with regard to the day-to-day care of the TIVADs are largely based on anecdotal experience. That there are variable approaches concerning the flushing and locking of central venous catheters as a result of deficiency in evidence is a notable example.[12] Up till now, there is no consensus to the optimal heparin concentration of the flush-lock solution. Concentrations at 0, 10, 25 and 100 units per milliliter have been reported.[13-16]

Interestingly, routine catheter flushing has been remarked as "a commonsense practice as no studies are available in the literature".[17] Until recently, the manufacturer's recommendation of 4-weekly flush-lock practice for TIVAD has been faithfully followed by most published nursing protocols. The practice is not without risks. In a multicentre study where ports were only accessed for flushing, Dal Molin et al reported an infection rate of 0.06 per 1,000 days.[18] The gynecologic oncologists from the Alert Einstein College of Medicine and Montefiore Medical Center were the first group who have challenged the routine practice of the 4-weekly flushing.[16] They put patients on 3-monthly intervals of flushing after completion of treatment. Of the 73 patients followed up, seven experienced signs of catheter blockade. However, the mean duration of accession in these seven patients was not different from the other patients who did not experience any problem in port patency (79 vs. 63 days, $p>0.05$). In a subsequent study from the same institution, a similar conclusion that port patency can be safely maintained with 3-monthly flush-lock is made.[19] Several groups have since attempted to study the safety and efficacy of prolonging the flush-lock intervals. Kefeli et al show that maintenance port flush-lock can be safely prolonged at 6-week intervals.[15] Palese et al show the interval can be extended to 8 weeks.[20] Ignatov et al observe that port patency can be effectively maintained when flush-lock is done every 12 weeks.[14] Interestingly, infectious complications only occurred in patients whose ports were accessed at shorter intervals in the latter study.[14] These studies are summarised in Table 2.

Our expanded experience as reported here confirms the

Table 1 Summary of the five occasions when the port was occluded without maintenance flush-lock

Patient No.	Age at access (years)	Diagnosis	Nationality	Reason for access	Interval from last use (days)	Remarks
1	5.5	Neuroblastoma	Indonesia	Disease relapse	304	Patency restored with urokinase
2	16.5	AML	Vietnam	Blood sampling	390	Device removed; urokinase not used
3	12.7	Osteosarcoma	Denmark	PET-CT scan	126	Patency restored with urokinase
4	18.0	ALL	Indonesia	Pneumonia	187	Patency partially restored with urokinase
5	4.7	LCH	Indonesia	Disease relapse	706	Patency partially restored with urokinase
6	2.1	MRT	China	PET-CT scan	152	Forward flow fine

ALL, acute lymphoblastic leukaemia; AML, acute myeloid leukemia; LCH, Langerhans cell histiocytosis; MRT, malignant rhabdoid tumour

Table 2 Published studies on extending the intervals of flush-lock for resting totally implantable venous access devices

References	Study period	Flush-lock solution /Regimen	Methods	Findings
Kuo et al.[16]	1988-2002	Heparin saline 500 units in 5 mL	Retrospective study	7/73 patients had catheter occlusion; mean flush-lock intervals were 80 vs. 63 days for patients with and without occlusion, respectively (p=0.28)
Girda et al.[19]	2003-2010	Heparin saline 500 units in 5 mL	Retrospective study	Catheter occlusion occurred in 1/30 accessions vs. 2/111 accessions for flush-lock intervals <90 days and ≥90 days, respectively (p=0.52)
Kefeli et al.[15]	2003-2005	Heparin saline 1,000 units in 3 mL q6wk vs. 500 units in 3.5 mL q4wk	Prospective cohorts	No catheter occlusion occurred in either cohorts
Ignatov et al.[14]	Not mentioned	Heparin saline 500 units in 20 mL	Retrospective	Catheter occlusion occurred in 6/227 patients with flush-lock intervals 1-8 weeks, 0/30 patients with intervals 9-12 weeks, and 2/26 patients with intervals ≥13 weeks (p=0.34)
Palese et al.[20]	2011-2012	Heparin saline 250 units in 5 mL	Retrospective	Catheter occlusion occurred in 4/20 vs. 2/17 patients with flush-lock intervals of 8 weeks and 4 weeks, respectively; or 0.84 and 0.52 per 1,000 days, respectively
Current study	2010-2017	Heparin saline 50 units in 5 mL	Retrospective	Catheter occlusion occurred in 6/89 accessions or 0.39 per 1,000 days

same low incidence of catheter occlusion even when the practice of flush-lock is discontinued when the TIVAD is not in use for eight weeks or more. Given that there is a lack of research to support the 4-week maintenance flushing, the published literature is indeed in favour of alternative approaches. Further research into the necessity of flush-lock maintenance of TIVAD is therefore warranted.

Translating into clinical practice, children with TIVAD are discharged from the hospital after the needle is removed. Parents are not required to take any precaution about the TIVAD and the children can shower and bath as their normal siblings. When anti-cancer treatment is completed, there is no urgency to remove the TIVAD. No special care or procedure is required until one to two years later when the risk of disease relapse is considered low enough for the TIVAD to be removed. Note that in eight children when their diseases relapse, the same TIVAD could be used again for the second treatment.

Disclosure/Conflict of Interests

None

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