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Management of functional complications of totally implantable venous access devices by an advanced practice nursing team: 5 Years of clinical experience

Godelieve Alice Goossens [a,b,*], Marguerite Stas [a], Philip Moons [b]

[a] Department of Surgical Oncology, University Hospitals Leuven, Herestraat 49, B-3000 Leuven, Belgium
[b] Center for Health Services and Nursing Research, Katholieke Universiteit Leuven, Kapucijnenvoer 35, Box 7001, B-3000 Leuven, Belgium

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A B S T R A C T

Purpose: Our aim is to describe the number and distribution of requests addressed to an Advanced Practice Nursing team for functional problems of totally implantable venous access devices (TIVADs) and to describe, in detail, the malfunction management by the type and number of additional investigations and treatment modalities.

Method: The Advanced Practice Nursing team recorded data about all requests for support as part of the standard care. A specific protocol, the Leuven Malfunction Management Protocol was used for trouble-shooting. In this descriptive, retrospective study, data of 3950 consecutive requests for TIVAD-related functional problems in 2019 patients were analyzed. Data collection included (1) demographic information, (2) device-related details, and (3) malfunction and follow-up details.

Results: 'Easy injection, impossible aspiration' was the most frequently documented functional problem (66.9%) for all requests for help. Of all malfunctions, catheter tip was in an optimal position in 73.4%, thrombolytics were administered in 59.0%, and a linogram was performed in 4.9%. TIVAD removal/exchange was advised in 4.4% of the requests.

Conclusions: TIVAD malfunction—defined operationally in terms of injection and/or aspiration problems—reflect all functional complications encountered in practice. Adherence to the Leuven Malfunction Management Protocol can ensure that, in most cases, catheter patency can be fully restored without removing or replacing the TIVAD. The Advanced Practice Nursing team coordinates the following treatments, investigations, and procedures: radiological catheter tip verification; thrombolytic agent administration and, if necessary, subsequent injection of solutions to dissolve drug precipitates or lipid deposits; linogram; percutaneous sleeve stripping; and TIVAD removal/replacement.

Introduction

Implantable ports or totally implantable venous access devices (TIVADs) such as port-a-cath, have become an important and safe tool in treating chronic diseases. In cancer patients TIVADs are used primarily for chemotherapy administration and blood sampling. Therefore, well-functioning devices are highly desired. However, malfunction can occur according to different degrees of injection and/or aspiration problems. Reported malfunction incidence rates in the adult onco-hematology populations vary between 0% and 47% of inserted TIVADs and between 0.24% and 26% of accessions (Goossens et al., 2011). In addition, functional problems have multiple causes, such as incorrect needle placement, catheter tip thrombosis (CTT), incorrect catheter tip location, catheter sleeve formation, catheter tear or embolization, intraluminal clot formation, port chamber defect, drug precipitate accumulation in the port reservoir, superior vena cava (SVC) thrombosis and perforation (Hardy and Ball, 2005; Krzywda, 1999; Schulmeister, 2010; Schummer et al., 2003; Stephens et al., 1995; Surov et al., 2008). After accessing a port, oncology nurses have been estimated to spend an extra 27.1 to 29 min on troubleshooting problems due to malfunction (Lamont et al., 2003). Malfunction compromises treatment and causes stress to patients and health care providers.

Once a malfunction occurs, a broad range of measures is available for troubleshooting. Troubleshooting starts with a careful clinical examination and meticulous history taking. Additional investigations, such as a chest X-ray or contrast dye injection through the device (linogram), can determine the origin of the malfunction. Depending on the findings, treatment can be initiated with thrombolytics or solutions that dissolve drug precipitates and

* Corresponding author. Department of Surgical Oncology, University Hospitals Leuven, Herestraat 49, B-3000 Leuven, Belgium. Tel.: +32 16 346831; fax: +32 16 346834.
E-mail address: godelieve.goossens@uzleuven.be (G.A. Goossens).

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lipid deposits. Sometimes more invasive interventions are needed, such as percutaneous sleeve stripping (PSS) (Heye et al., 2011), catheter repositioning, or even whole device replacement. However, health care providers in charge of patients with TIVADs often lack knowledge about how to deal with the management of functional complications. An Advanced Practice Nursing team (APN team), a group of nurses specifically trained to troubleshoot complications involving venous access devices, may therefore be of added value. Indeed, their specific clinical expertise enables them to provide expert advice and advanced care to patients (Goudreau et al., 2007). The purpose of this paper is to determine the number, type, and distribution of: (1) requests for malfunction, (2) supplementary investigations, (3) thrombolytic and other treatments.

Methods

Advanced practice nursing team

The University Hospitals Leuven (UHL), Belgium, has an APN team belonging to a larger reference team for long-term venous access systems. The reference team consists of five specialized nurses of the APN team and two oncology surgeons. The APN team specializes in preventing and troubleshooting complications involving venous access devices. Managing TIVAD malfunctions is one of its major duties. The APN team works in close collaboration with treating physicians and physicians belonging to the departments of vascular medicine and hemostasis, interventional radiology, and microbiology; with pharmacists; and also with head nurses, staff nurses, and community nurses. Although the team focuses on problems occurring in long-term devices, they deal with problems associated with other types of access systems, such as non-tunneled central venous catheters (CVCs), especially those in hematological patients.

In cases of device malfunction, staff nurses are trained to initiate measures to restore patency. Most of these measures involve freeing the catheter tip from the vein wall, sleeve, or blood clot by repositioning the patient or by changing intrathoracic pressure. If attempts are unsuccessful, nurses can contact the APN team for further help. The team acts according to the Leuven Malfunction Management Protocols (LMMPs), which describes in detail the standard procedures for handling malfunctions. The APN-team developed the LMMPs, which were progressively improved along new insights over the years, The LMMPs provide a support to the team in a logical approach of the problems although not all steps of the LMMPs could be underpinned with evidence.

For each request for help, the APN team asks the requester details related to the malfunction aspects (e.g., difficulty or inability to inject, to aspirate, or both). The data were registered on a specific designed form, which is included in the hospital information system (HIS): this enables the team and other care givers to review all contact details.

Device insertion and maintenance

At the UHL, oncology surgeons insert TIVADs by means of per-operative electrocardiographic guidance for catheter tip positioning. The procedure takes place in the operation theatre. The patients are usually under local anesthesia and are not required to take prophylactic antibiotics. Intravenous therapy through the device can begin on the day of insertion, if needed.

Clot formation is prevented by performing a pulsated flush method at the end of each infusion therapy session. After delivering 10 ml of normal saline (NS) through the device a positive-pressure lock is established. Positive pressure is maintained by closing the clamp on the extension set of the puncture needle (or the three-way stopcock) while injecting the last millilitres of solution at a constant flow rate. A flush of 10 ml of NS is used soon after accessing the port, and prior to and after each blood sampling. After administration of packed cells or parenteral nutrition, 20 ml of NS is flushed. A 3 ml heparinized saline (100 IU/ml) lock is used prior to Huber needle removal. When the device is in use, the Huber needle is changed weekly. Otherwise TIVADs are flushed every 6 to 8 weeks with 10 ml of NS followed by a 3 ml heparinized saline lock (100 IU/ml).

Design and data collection

This descriptive retrospective study was conducted from November 1, 2005, to October 30, 2010, at the UHL. The APN team recorded details of each single request for support for TIVAD problems as part of the standard care delivered by the team. From April 2008 onwards, the team switched from data collection on paper to a standardized electronic form that was integrated into the HIS. Data on functional problems (type of malfunction, suggested investigations and treatments, and results) were recorded by the team. Demographic information as gender, age, condition (malignant or not), and device-related details (insertion date, device type, vein used) were added retrospectively. Data were presented without any reference to individual patients.

Definitions

Definition and classification of functional problems

We defined catheter function according to the ability to inject and/or aspirate through this catheter. In all, there are nine different combinations based on how easy, difficult, or impossible injection and/or aspiration is. Hence, eight combinations describe functional problems in terms of difficult or impossible injection and/or aspiration, and one combination (easy injection and aspiration) describes a well-functioning catheter. Seven additional categories partially describe the malfunction problem, in cases in which injection and/or aspiration descriptions were incomplete. This results in 16 different operational definitions for malfunctioning devices and one definition for well-functioning devices.

Definition of correct catheter tip location

For catheters inserted through the SVC system, correct catheter tip location is in the vicinity of the lower one-third of the SVC, near the juncture with the right atrium (RA) (NAVAN Position statement, 1998). For catheters originating from the inferior vena cava system, optimal tip position is at the level of the transition between the inferior vena cava and RA (Wolosker et al., 2004). For devices inserted through the SVC, tip locations in the deep RA or the upper two-thirds of the SVC were considered suboptimal and tips located outside the SVC or RA were considered as clear malpositions.

Definition of administration modalities of thrombolytic agents or solutions to dissolve drug precipitates or lipid debris

We defined an instillation as an injection of product, which remains in the device for less than 4 h. By contrast, we defined a lock as an injection of product, which remains into the device for longer than 4 h (and up to 8 weeks) and a continuous infusion as an intravenous infusion of a product at a constant flow rate for a certain period of time.

Statistical analysis

All data were analyzed using SPSS 16 for Windows. Descriptive statistics for nominal data were expressed in absolute numbers and percentages. Medians and quartiles were computed for continuous variables with a non-normal distribution. Inferential statistical