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Original Research Article

Complications of totally implantable venous access devices: experience with 852 Moroccan cancer patients

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ABSTRACT

Background: Totally implantable venous access devices (TIVADs) provide easy vascular access in cancer patients for chemotherapy administration, blood products, parenteral nutrition and blood sampling. However, they are associated with several complications which can be divided into early and late. The aim of the present study was to evaluate the various complications related to TIVADs in a single center in Morocco.
Methods: This was a retrospective, observational, descriptive study conducted at the Medical Oncology Department of the Military Hospital Moulay Ismail in Meknes, Morocco, during a 6-year period, between January 1st, 2011 and December 31st, 2016. Author included all patients older than or equal to 18 years, with solid malignancies who had TIVAD placement for chemotherapy.
Results: A total 852 TIVADs were placed. There were 92 complications (10.8% of patients). Early complications included 16 (1.9%) cases of pneumothorax and 12 (1.4%) cases of arterial puncture with a cervical hematoma. Infection was the most common late complications (2.8%), followed by thrombosis (1.8), extravasations of cytotoxic drugs (1.3%), mechanical dysfunction of the catheter (1.3%) and skin necrosis (0.3%).
Conclusions: The results of the analysis confirm the safety and tolerability of TIVADs for chemotherapy administration in Moroccan patients, with similar rates of early and late complications compared to the published data.

Keywords: Cancer, Complications, Totally implantable venous access device

INTRODUCTION

Totally implantable venous access devices (TIVADs) consist of a reservoir that is inserted into subcutaneous tissue, usually in the anterior wall of the thorax and a silicone catheter whose distal extremity is positioned at the junction of the superior vena cava with the right atrium and whose proximal extremity is connected to the reservoir.[1,2] TIVADs provide easy vascular access in cancer patients for administration of chemotherapy, blood products, parenteral nutrition solutions and taking blood samples for tests.[3,4] Despite its benefits, they are associated with several complications which can be divided into early and late. Early complications include hemothorax, pneumothorax, injury to large blood vessels, air emboli, cardiac arrhythmia and malposition of the catheter. Late complications comprise infections, venous thrombosis, extravasations of cytotoxic drugs, mechanical dysfunction of the catheter and skin necrosis.[5,6]

The introduction of TIVADs started in the early 1980s.[4] Today, these devices are widely used around the world in recent years, but few studies have been done in Morocco, especially with a significant number of cases and long-term follow-up. In the present study, author retrospectively evaluated the various complications related to TIVADs in a single center in Morocco.

METHODS

This was a retrospective, observational, descriptive study conducted at the Medical Oncology Department of the Military Hospital Moulay Ismail in Meknes, Morocco, during a 6 years period, between January 2011 to December 2016. Author included all patients older than or equal to 18 years, with solid malignancies who had TIVAD placement for chemotherapy.

All TIVADs were placed by the same team of four surgeons experienced in venous access with the assistance of the anesthesiologist. The TIVADs insertion was performed under fluoroscopic guidance, in the operating room. A chest X-ray was routinely performed after the procedure to confirm the position of the catheter and to exclude a pneumothorax. Information regarding patients' age, sex, type of malignancy, placement side, the vein of insertion and complications related to TIVADs was collected. Complications were classified into two main categories: early complications, occurring intraoperatively or postoperatively before the first use of the TIVADs; and late complications, occurring after the first use of the TIVADs.

The statistical analyses were accomplished by IBM computer using Epi Info version 7.2. Quantitative data were expressed as mean±standard deviation (SD) or median values with range. Qualitative variables were reported as numbers with percentages.

The study was performed according to the second principles of the Declaration of Helsinki and approved by the Ethical Committee of the Military Hospital Moulay Ismail. As it is a retrospective study and no data could lead to the identification of any patient, the request for dismissal of the informed consent was approved by the Ethical Committee.

RESULTS

A total 852 TIVADs were placed at the Department of Surgery of the Military Hospital Moulay Ismail in Meknes between January 2011 to December 2016 and all patients received chemotherapy in the Department of Medical Oncology. A total 391 patients were female (45.9%) and 461 males (54.1%). Mean age was 59.2±14.2 years and median age 57.4 years (range: 18 - 82).

The patients presented various cancers, predominantly breast (27%), gastrointestinal (24%), lung (21%), upper airways (9%), urological (8%), gynecological other than breast (7%) and others (4%) (Table 1).

Table 1: Patients characteristics.

Characteristics	No. of patients	Percentage
Total of patients	852	100%
Age		
Median	57.4	
Range	18-82	
Sex		
Male	461	54.1%
Female	391	45.9%
Cancer location		
Breast	230	27%
Gastrointestinal	204	24%
Lung	179	21%
Upper airways	77	9%
Urological	68	8%
Gynecological other than breast	60	7%
Others	34	4%

The median duration over which TIVADs remained in place was 22.8 months (range 1-60 months). In 77% of the patients, TIVADs were implanted in the subclavian vein, followed by the internal jugular (15%), cephalic (6%) and external jugular (2%) veins (Table 2).

Table 2: TIVADs implantation sites.

Site	No. of patients	Percentage
Vein of insertion		
Subclavian vein	658	77%
Internal jugular vein	132	15%
Cephalic vein	50	6%
External jugular vein	12	2%
Placement side		
Right	724	85%
Left	128	15%

The implantation and use of TIVADs were accompanied by complications in 92 (10.8%) patients. Early complications included 16 (1.9%) cases of pneumothorax and 12 (1.4%) cases of arterial puncture with a cervical hematoma. Infection was the most common late complications (2.8%), followed by thrombosis (1.8), extravasations of cytotoxic drugs (1.3%), mechanical dysfunction of the catheter (1.3%) and skin necrosis (0.3%) (Table 3).

DISCUSSION

Cancer patients often require repeated administrations of chemotherapy, parenteral nutrition, and antibiotics or are usually required to provide blood samples. Most

cytotoxic agents are associated with significant venous toxicity and often lead to venous thrombosis if peripheral veins are used.[7] TIVADs have therefore substantially facilitated the problem of vascular access and revolutionized the care and quality of life for cancer patients. To date, TIVADs have become an integral part of the daily clinical routine in oncology.[4,8] However, there are several complications associated with TIVADs. From the pathophysiological point of view, early complications arise due to injury to adjacent structures during reservoir implantation and catheter insertion, whereas late complications occur as a result of long-term catheter indwelling and reservoir disintegration due to improper use or trauma (Table 4).[1]

Present study revealed that TIVADs are a safe and effective way of long-term intermittent central venous access, with an overall complication incidence of 10.8% during the entire devices duration.

Table 3: Early and late complications related to TIVADs.

Complications	No. of patients	%
Total complications	92	10.8%
Early	28	3.3%
Late	64	7.5%
Early complications		
Pneumothorax	16	1.9%
Arterial puncture with cervical hematoma	12	1.4%
Late complications		
Infection	24	2.8%
Thrombosis	15	1.8%
Extravasation of cytotoxic drugs	11	1.3%
Mechanical dysfunction of the catheter	11	1.3%
Skin necrosis	3	0.3%

Table 4: TIVADs related complications.

Early complications		Late complications	
Catheter insertion	**Reservoir implantation**	**Catheter related**	**Reservoir related**
• Pneumothorax • Hemothorax • Arterial puncture • Hematoma	• Wound dehiscence • Hematoma • Seroma • Wound infection	• Catheter occlusion • Catheter misplacement • Thrombosis infection • Pinch-off syndrome • Catheter embolization	• Reservoir fracture • Reservoir rotation • Drug extravasation • Reservoir membrane disruption

The great majority of TIVADs remain in situ and complication-free until the death of the patient or end of the treatment. In many retrospective studies, the complication rate varied between 6 and 21% and is consistent with the findings.[2,5,7,9–20]

Furthermore, in accordance with recent studies, author observed a decreasing trend for early complications.[21] Rare major complication as described in case series reports, such as air embolism, hemothorax, brachial plexus injury and pericardial tamponade did not occur in the series.[22-25] As in other studies, the main early complication observed in present study was the pneumothorax, occurring in 1.9% of patients.[1,26-29] It is thought to be higher with the blind subclavicular approach and with the multiple attempts of needle passage.[21] In catheterization of the internal jugular vein, the use of ultrasound guidance has been shown to decrease the risk of pneumothorax. Treatment ranges from simple observation to thoracostomy tube insertion, depending on size and emergence of symptoms.[1,8] Accidental arterial puncture occurs in 2%-4.5% of central venous catheterizations, resulting in arterial injury in 0.1%-0.5% of patients.[8,30] In the series, author observed 12 (1.4%) unintended arterial puncture. They did not require any treatment except for a longer ultrasound follow up.

The most frequent late complication in present study was the infection (2.8% of the patients), followed by thrombosis (1.8%). Other late complications, including extravasations of cytotoxic drugs, mechanical dysfunction of the catheter and skin necrosis, occur very rarely (2.9% altogether). In one recent review, the infection can complicate TIVADs in up to 4.8% of the cases.[8] This data is confirmed by the results. Risk factors of infection of TIVADs include frequent access, total parenteral nutrition, neutropenia, chronic steroid use, thrombosis, metastatic disease and hematologic malignancy as compared with solid tumors.[31-34] Bacteriologically, the most common causative agents are coagulase-negative Staphylococci, gram-negative Bacilli, Staphylococcus aureus, Pseudomonas aeruginosa and Candida species.[1,31]

Management begins with empirical broad-spectrum antibiotics. If the patient has sequential organ failure score greater than or equal to 2, endocarditis, suppurative thrombophlebitis, osteomyelitis or any other hematogenous dissemination, TIVAD should be removed and long-term antibiotics are given based on the culture sensitivity results. Furthermore, if the causative agents are Staphylococcus aureus or Candida species.[35] TIVAD needs to be removed in most cases. Otherwise, antimicrobial lock therapy associated with systemic

antibiotics should be tried to salvage TIVAD.[1,31,36] The cumulative rate of symptomatic thrombosis associated with TIVADs has been reported to be between 2 and 13% and is approximately consistent with the findings.[7,37-40] Once thrombosis is diagnosed, Anticoagulation with low molecular weight heparin and fondaparinux are preferred over unfractionated heparin for acute management and should be continued for at least three months or until TIVAD is in place. Current CHEST guidelines recommend that TIVADs should be removed only if not needed or non-functional.[1,37]

CONCLUSION

The results of the analysis confirm the safety and tolerability of TIVADs for chemotherapy administration in Moroccan patients, with similar rates of early and late complications compared to the published data. Reduction of these complications is possible with proper implantation and maintenance techniques and through the combined efforts of surgeons, medical oncologists, and nursing staff.

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