Portacath Implantation in Ghana: Initial Experience at the Komfo Anokye Teaching Hospital in Kumasi

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Isaac Okyere[1,2], Perditer Okyere[3], Sanjeev Singh[2] and Samuel Gyasi Brenu[4]

[1]Department of Surgery, School of Medicine and Dentistry, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. [2]Department of Anesthesia and Intensive Care, School of Medicine and Dentistry, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. [3]Department of Internal Medicine, School of Medicine and Dentistry, College of Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. [4]Directorate of Surgery, Komfo Anokye Teaching Hospital, Kumasi, Ghana.

ABSTRACT: Current practice for chemotherapy in most oncology departments is the use of dedicated venous access for the continuous and frequent delivery of drugs, fluids and blood products, and the monitoring of the effects of treatment. The frequent venipuncture of peripheral veins is associated with various complications and discomfort to the patients. Permanent central venous access is therefore very important. Totally Implantable Vascular Access Device (TIVAD) is a type of central venous access that utilizes the central veins; the internal jugular vein, the subclavian or the femoral veins. It is a kind of permanent central venous access where a central venous catheter is connected to a subcutaneously buried port or septum which can be accessed at any time and has the ability to stay for almost 5 years. They are therefore the preferred form of long-term central venous access in patients treated by oncology departments. We share our initial experience of 5 patients in our institution. There were 4 females and one young boy who had been diagnosed with Hemophilia. Three of the patients had new implantation, one had removal of her 5-year-old TIVAD that had been implanted in another country and one had the TIVAD accessed when she had been referred to our hospital for breast surgery after neoadjuvant chemotherapy.

KEYWORDS: Portacath, ports, internal jugular vein, subclavian vein, modified seldinger technique

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CORRESPONDING AUTHOR: Isaac Okyere, Department of Surgery, Kwame Nkrumah University of Science and Technology, Knust, Kumasi, Ghana. Email: isaac.okyere@knust.edu.gh

Introduction

By introducing different chemotherapeutic agents and considering the complexities of anti-cancer treatment protocols, the need for reliable vascular access has significantly increased in 2 recent decades.[1] Patients with malignancy usually need repeated venipuncture for chemotherapy, total parenteral nutrition, blood product transfusions and venous blood sampling. Therefore, long-term, reliable central venous access is demanded in order to meet the requirements of multimodality intravenous therapy. TIVADs such as Ports, portacath have been advocated for to improve venous access reliably.

Totally implantable Vascular Access Devices have several advantages over other methods of venous access. One advantage is the ability for them to be implanted under local anesthesia as an outpatient procedure, thereby reducing costs. Prior to the publication by Morris et al. in 1992 where port implantation was carried out in an angiography unit, this procedure was initially performed by surgery departments under general anesthesia.

Methods

Setting: The setting was the cardiovascular and Thoracic surgery unit of the department of surgery of the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. KATH is the second largest hospital in Ghana with a 1000 bed capacity and runs a number of specialized clinics including the cardiovascular and thoracic surgery unit.

Study population: all patients who were referred to the cardiovascular and thoracic surgery unit for portacath implantation or removal over a period of 5 years from January 2015 to June 2020.

Study design: we performed a retrospective analysis of our hospital database of all patients who were managed in the unit for portacath over the 5 year period, from January 2015 to June 2020. A total of 5 cases were analyzed. The hospital Data collected included basic demographics, the clinical diagnosis of the patients, the type of TIVAD, the side of implantation, the type of vascular access, and the outcome.

Data analysis: data was analyzed with Social Package of Statistical Sciences (SPSS) software version 22.0 (IBM Corp. Armonk, NY, USA). Simple mean, standard deviation and range was calculated.

Results

The mean age of the 5 patients was 38.7 years with the youngest patient being 8 months and the oldest being 63 years. There was one male with 4 females in a ratio of 4:1. They all had implantation of a single lumen portacath. Two of the patient had the implantation through the internal jugular vein and the remaining 3 had all the implantation via the use of the

subclavian vein. The right and the left internal jugular veins were used for the 2 patients who had access through the internal jugular vein and all the subclavian veins were accessed via the left. One of the patients had a kinked catheter and had to go back for revision and reinsertion and one had superficial site infection, with one patient having hematoma formation after implantation. The following is the detailed description of each case

Case 1

A single-lumen Portacath; BarbPort ʳ x-Port ***isp, Mexico,*** was inserted in an 8-month-old child who had been diagnosed with Factor VIII hemophilia for recurrent factor transfusion. Prior to the portacath implantation by the cardiothoracic surgeon, the child had been coming to the hospital for weekly factor VIII transfusion and the pediatric oncologist had to struggle for intravenous access with bleeding complications. The patient was therefore referred to the cardiothoracic surgeon for TIVAD implantation. After initial assessment and stabilization, informed consent was taken from the mother for surgery. In theatre with general anesthesia and under aseptic conditions, and Factor VIII transfusion through a peripheral vein, the right neck and chest were prepped up and isolated. The right internal jugular vein was assessed with USG guidance using the modified Seldinger technique. The Guidewire was left in situ and a right infraclavicular incision pouch created for the septum of the portacath. The catheter was then tunneled through into the superior vena cava via the guidewire after dilatation. The position was confirmed with positive withdrawal of blood and the catheter was then connected to the septum and buried in the septal pouch created. The wound was then cleaned and closed up in layers as shown in Figure 1. The patient was transfused 2 units of Factor VIII right in theater before on-table extubation. He had hematoma formation in the pouch on postoperative day 2 which resolved spontaneously and was discharged home after 5 days. He has been having weekly factor VIII transfusion using the Portacath for the past 4 years. He was followed up on outpatient basis for 4 years. Figure 2 shows the postoperative chest x-ray of the patient showing the venous catheter and the port. Figure 3 show the patient 3 years after the surgery. The portacath was removed 4 years after surgery as the child was receiving subcutaneous injection of the Factor VIII Concentrates by the pediatricians.

Case 2

A young woman of 43 years undergoing chemotherapy after right mastectomy and breast reconstruction was referred to the cardiothoracic surgeon for possible TIVAD implantation after having challenging times for venous access. She was assessed and booked for surgery after basic laboratory work and informed consent. Under aseptic conditions and local infiltration with plain 1% lidocaine, the left subclavian vein was

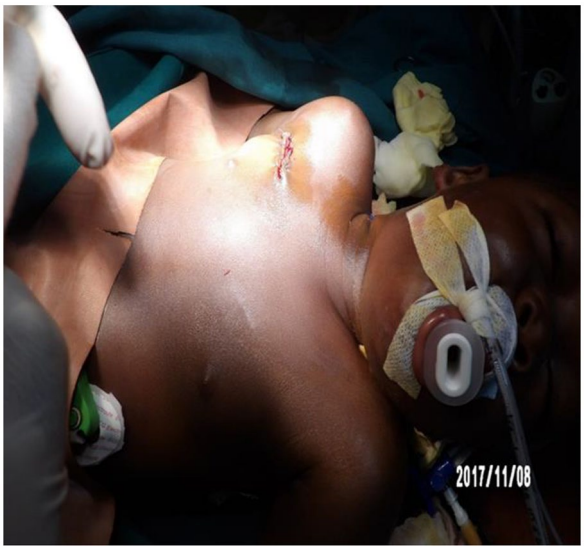

Figure 1. Intraoperative picture showing the buried Port.

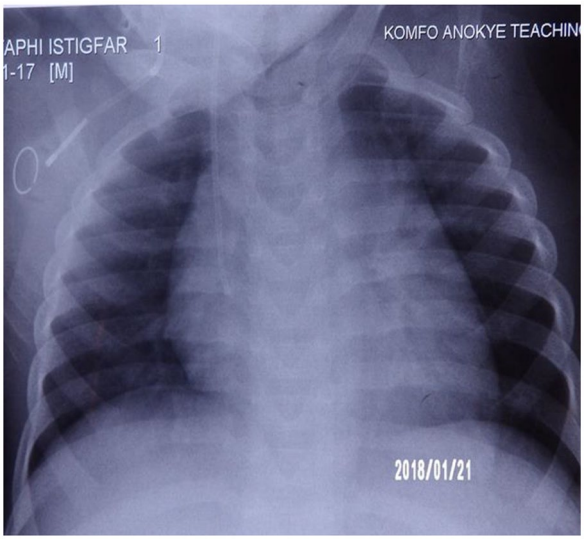

Figure 2. Postoperative chest X-ray showing the port.

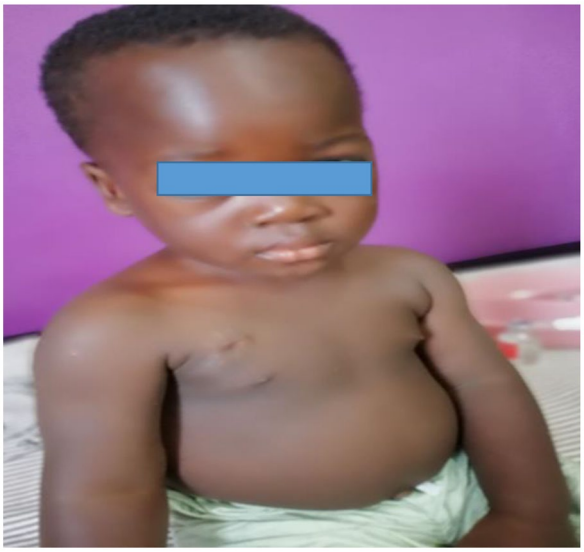

Figure 3. Showing the patient 2 years after the surgery.

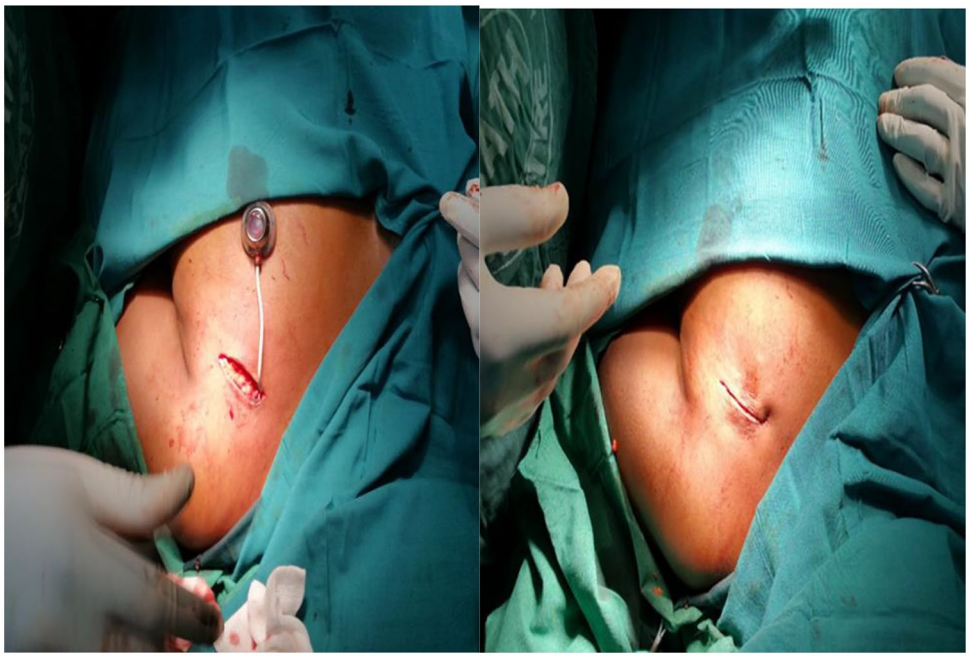

Figure 4. Showing the infraclavicular incision, the catheter, the septum and the wound closure after burying the septum.

accessed via the modified Seldinger technique. The guidewire was left in situ as usual and the catheter threaded over it after dilatation. A pouch was created below the left infraclavicular region and the septum of the portacath connected to the catheter with patency confirmed by positive withdrawal of blood and push without tension. The catheter was then flushed with 10 ml of heparinized saline constituted using 500 units of heparin. The wound was closed up in layers. She was discharged the next day and continues to be stable 1 year after surgery and completing her chemotherapy. Figure 4 shows the intraoperative picture of the patient with the implanted catheter and the septum. The TIVAD was removed 1 year after implantation.

Case 3

This was a 63-year-old female who was having a five-and-half-year-old TIVAD which had been inserted for chemotherapy abroad after her breast cancer surgery. She was stable and the Portacath had not been used for over 3 years even though it was being heparinized every 3 months. She was referred to our unit for possible removal of the implant. All baseline laboratory investigations and chest x-ray were found to be normal. she was therefore booked for removal under local anesthesia. After seeking informed consent and under aseptic conditions and local infiltration with 1% lidocaine, a left infraclavicular incision over the septum of the port was made after localizing and fixing it with the left hand. Dissection, isolation and removal of the septum with the catheter was done. The pouch made for the septum was cleaned with povidine-iodine and the wound closed up in layers. She did well and was discharged home on postoperative day 2 with analgesia and antibiotics for follow-up for 3 months initially. She has been doing well for the past 3 years without any complications or complaints.

Case 4

A 45-year-old woman was referred from a cancer center with a portacath which had been inserted at the center for neoadjuvant chemotherapy for right breast carcinoma to our center. She had been referred to the general surgical unit of our facility for a modified radical mastectomy. Preoperative hemoglobin level was 8.2 g/dl and needed an intravenous access for preoperative blood transfusion but due to the challenge for venous access, the cardiothoracic surgery team was called to assist with the access of the portacath. The portacath was successfully accessed and the patient was successfully transfused 3 units of packed cells before surgery. At surgery, the cardiothoracic surgery team was once again called to access the portacath for use by the anesthesiology team and this was also successfully done. The port was used for the postoperative management as well until patient was discharged home on postoperative day 5 to continue her clinic at the breast and the oncology units of the hospital.

Case 5

The last case was a 40-year-old lady who has had modified right mastectomy for carcinoma of the right breast after she had been recently diagnosed. There was a challenge for venous access for her adjuvant chemotherapy and therefore was thus referred to the cardiothoracic surgeon for portacath implantation. After stabilization and informed consent, a size 8F Polyurethane Open-Ended Single-Lumen, M.R.I™ Implantable Port was implanted via the left internal jugular using the modified Seldinger technique and burying the septum below the left clavicle. There was negative withdrawal when it was due in 2 weeks for access by the oncology nurses because of kinked

Table 1. Clinico-demographics of the Patients and the Portacath.

CASE/ DIAGNOSIS	AGE	SEX	TYPE OF PORTACATH	TYPE OF VENOUS ACCESS	SIDE	COMPLICATION
1. Hemophilia VIII	8 month	M	Single-Lumen	Internal Jugular	Right	Hematoma formation
2. Right Breast Carcinoma	43 year	F	Single-Lumen	Subclavian	Left	No
3. Right Breast Carcinoma	63 year	F	Single-Lumen	Subclavian	Left	No
4. Right Breast Carcinoma	45 year	F	Single-Lumen	Subclavian	Left	No
5. Right Breast Carcinoma	40 year	F	Single-Lumen	Internal Jugular	Left	Kinked Catheter and had revision

catheter and the port had to be revised again. Subsequently she had been using it without any challenge or complaints.

Discussion

Since the discovery of vascular anatomy in the 17th century, various interventions such as blood transfusion and intravenous fluid infusion have been described using various improvised materials up until 1945 when the first commercially-made catheter for intravenous infusion known as Intracath® was made.[1] This was later followed by the description of venipuncture of the subclavian vein for rapid fluid transfusion. This was particularly invaluable since a military surgeon discovered it in 1952 who utilized it in management of hypovolemic shock on the battlefield. Later that year, the discovery of the Seldinger technique formed the foundation of endovascular and interventional radiology procedures.[1,2] Use of central venous catheters via peripheral veins in the upper and lower limbs were first described in 1960 by Wilson who utilized it in monitoring of central venous pressures amongst cardiac and critically ill patients. However, the internal and external jugular veins were soon catheterized.[2] The subclavian vein eventually became a possible percutaneous access point for a central venous catheter in 1965 when it was described by Yoffa.[1,2]

Evolution of vascular access took a significant step in advancement when Broviac in 1973 created a central venous catheter that is tunneled in the subcutaneous tissue to exit point on the chest. This was even further perfected in 1979 by Hickman to a larger caliber catheter for chemotherapy and parenteral nutrition.[1,2]

The invention of the totally implantable vascular access devices in 1982 by Niederhuber revolutionized the management of cancer patients. He described a vascular access device with its tip in a central vein and an infusion port totally embedded subcutaneously.[1,2]

Components

The portacath is a totally-implantable vascular access device comprising of a port or hub and an intravascular catheter inserted either via a peripheral or a central vein.[2,3] It comprises of a titanium, plastic or stainless steel injection port housing a silicone septum.[2,4] First-generation ports made were heavy with no adjustment made based on the age and weight of the patient. However, recent ports are lighter with variable sizes based on the age and weight of the patient.[2] The port may be a single-chamber or double-chamber. It may also be valved or valveless, a feature whose importance is yet to be confirmed.[1] The septum of the port allows numerous punctures with the Huber needle, which are non-coring needles specially-made for puncture of ports.[2] All the 5 cases in our review had a single-lumen catheter implanted, with two(2) of the patients using the internal jugular venous access whereas the other 3 had the subclavian venous access as shown in Table 1.

The intravascular catheters, which are connected to the port, are manufactured from either silicone or polyurethane. Silicone catheters are more biocompatible and offer reduced risk of thrombosis. Polyurethrane catheters may have larger luminal diameters because of their durability which offers the ability to produce catheters with thinner walls.[2] They may be directly connected to the port and sealed right from the factory or assembled together during insertion.[2] All our ports were made of polyurethane catheters.

Indications and Contraindications

The invention of the port catheters have revolutionized the current management of oncologic diseases since it overcame the need for serial venipunctures for peripheral access to administer chemotherapeutic agents, antibiotics, or withdrawal as well as administration of blood.[5,6] Portacaths are preferred to both Hickman lines and peripherally inserted central venous catheters due to their significantly reduced risk of catheter-related bloodstream infections and thrombosis as well as their accompanied less limitation of daily activities.[6,7] It has been found invaluable in the administration of medications for which peripheral access is contraindicated such as chemotherapeutic agents and parenteral nutrition.[5,7,8]

The widespread use of the portacath in oncology is well emphasized by various studies. Breast cancer has been found to be the most common solid malignancy for which use of a portacath is indicated according to reports by different authors[6,7,9]

while Madabhavi and colleagues demonstrated that acute lymphoblastic leukemia was the most common hematological malignancy for which portacath was utilized in management.[6] All the 4 women in our series were breast cancer patients.

Patients with non-oncologic hematologic diseases who require a reliable vascular access for administration of blood products such as hemophiliacs are good candidates for portacath insertion.[2] Alkindi along with his associates reported of a study where portacath was utilized in the long-term management of patients with sickle cells disease[10] and we had one child who had hemophilia and needed a dedicated intravenous access for weekly Factor VIII transfusion for whom a portacath was implanted.

Portacath insertion has no absolute contraindication. However, documented relative contraindications of portacath insertion include coagulopathy, bacteremia or presence of an ongoing infection with potential to lead to bacteremia, presence of thrombus in superior vena cava or SVC syndrome at insertion site or documented allergy to device material.[2] Our child with the hemophilia had to be given factor VIII transfusion in theater via a peripheral vein before the portacath implantation and he received another 2 units after implantation right in theater.

The portacath catheters have been found to be capable of remaining functional for long periods of time. Samad et al reported an average duration of 22 months for which portacath remained in situ while Granic and colleagues reported an average of 16 months.[9,11] We have experience in explanting or removing 3 Portacaths. The first one being the **Case 3**, the 63 years old woman who had her portacath implantation in another country and had to be removed after five(5) and half years. The second was **Case 1**, the boy with hemophilia who he had his portacath removed after 4 years. The last one was the **Case 2**, and that was removed after 1 year.

Technique

Since 1982 when the first port catheter was implanted via the cephalic vein, various vascular access points have been described to date. The options have grown to include the subclavian, internal and external jugular, axillary, femoral, saphenous and gonadal veins.[2] Port catheters were initially inserted via an open surgical approach but the increased demand coupled with the invention of the Seldinger technique led to the widespread use of the percutaneous approach.[1,2,9] However, this has also coincided with an increase in the occurrence of potentially life-threatening complications such as haemopneumothorax or pneumothorax.[2] The subclavian vein is the most commonly used vein accessed via the percutaneous method even though other deep veins such as the internal jugular and femoral are also good access points.[1,9] Since its invention, it has become widely utilized as depicted in multiple studies published.[4,7,9,11] Majority of our patients utilized the subclavian vein as access. Three out of the 5 patients utilized the subclavian with 2 using the internal jugular vein. Even though the clinical status of the patient plays a significant role in the choice of anesthesia, local anesthesia is generally deemed to be satisfactory.[1] Several studies have reported port catheters implantation under local skin infiltration or anesthesia.[4,7,9] Of the 250 cases of port catheter implantations used in the study by Samad and friends, only 2 cases required general anesthesia due to severe anxiety.[11] Our experience included the use of general anesthesia only in the child while all the adults had the implantation under local anesthesia with 1% lidocaine.

The surgical approach to port catheter implantation consists of dissection and isolation of the selected vein and subsequent venotomy and insertion of the catheter with the tip at the level of the junction between the right atrium and the superior vena cava. This coincides with the level of the carina on fluoroscopy.[2] The Seldinger technique involves catheterization of the selected vessel over a metal guidewire initially passed.[11] Subsequently, a pocket is created to house the port, which is then fastened to the underlying muscle fascia with non-absorbable sutures so as to prevent rotation. Ideally, a 2-cm skin thickness overlying the silicone septum is deemed adequate to allow easy access. As such, obese patients may require a pocket carefully fashioned within the subcutaneous fat to house the port.[1,2] The catheter is then connected to the port already flushed with saline as shown in Figure 4 and patency confirmed with a saline flush which is followed up with a heparin flush.[1] As seen in the reports by Samad and associates as well as Loh and Chui, antibiotic prophylaxis is routinely not recommended since it is a clean surgery.[7,11] However we implanted the portacath percutaneously using the modified Seldinger technique under antibiotic cover of 1 g of ceftriaxone in the adults and 500 mg (using 50-75 mg/kg dose) in the child.

Complications

Immediate complications associated with portacath insertion documented in literature can be categorized into those associated with the vascular access process and those to do with the vascular cannulation such as cardiac muscle injury.[1] Complications associated with gaining of vascular access include pneumothorax, hemothorax, iatrogenic arterial puncture with hematoma formation.[1,11] Incidence of hemothorax has been reported to range between 1% and 11% .[2] Zerati et al showed that risk of pneumothorax was commonly associated with punctures of the subclavian and the jugular veins. Also, their study showed that percutaneous puncture under ultrasound guidance was associated with a lower risk of iatrogenic arterial puncture but was not important in reducing the risk of pneumothorax or Hemothorax.[1] We used ultrasound guidance for the implantation only in our **Case 1.**

Late complications associated with portacath insertion include infections, malposition, catheter dislodgement with extravasation, thrombosis, catheter migration and catheter failure.[1,11-13] Catheter-related infections may be limited to the

port pocket or extend into the bloodstream.[7,11] It is most commonly caused by Staphylococcus species and has been documented to be the most common cause of early portacath removal.[7,11] Portacath dislodgement has been reported in several literature with incidence of 4%.[11-13] Lin and colleagues reported of a case of haemopericardium that developed following dislodgement of a port catheter during port flushing. Mechanism of haemopericardium thought to be as a consequence of the vigorous flushing which resulted in dislodgement of the catheter and subsequent perforation of the thin-walled right atrium.[12] Extravasation has been reported in literature with an incidence of 0.9% to 6.5%. It may cause skin necrosis and subsequent extrusion of the port especially when port is being utilized for chemotherapy.[2] Other rare but documented complications include air embolism, cardiac arrhythmias due to abnormal positioning of the catheter tip and catheter thrombosis.[2] The only complication recorded in our series was port-site hematoma in the child with hemophilia which resolved spontaneously after Factor VIII transfusion and antibiotic cover.

Limitations: *small sample size*

Conclusion

Portacath implantation for intravenous access for oncologic or haemoglobinopathic patients is life-saving and should be encouraged even in less resourced centers.

What is known about this topic

- TIVAD is the main vascular access for chemotherapy for most well-established oncology centers in world
- There is limited experience and data on TIVAD use in most developing world

What this study adds

- Portacath implantation and use is possible even in resource limited centers
- There are few complications in portacath implantation in resource limited centers but great patient satisfaction and comfort

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Author Contributions

Isaac Okyere performed all surgeries, conceived the idea, did data collection and analysis and wrote the manuscript including the literature review. Sanjeev Singh did a critical review of the manuscript. Perditer Okyere did a review of the literature and provided critical revision to the manuscript. Samuel Gyasi Brenu provided critical revision to the manuscript. All authors read and approved the final copy of the manuscript.

ORCID iDs

Isaac Okyere https://orcid.org/0000-0002-2008-6978

Sanjeev Singh https://orcid.org/0000-0002-0184-3996

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