Original Article

Assessment of Peripheral Intravenous Catheter Site in Oncologic Patients Receiving Chemotherapy: Delphi Technique

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Background: A peripheral intravenous catheterization is performed for injecting therapeutic agents into the blood stream. However, it is not easily done in most cancer patients due to the abnormalities of blood vessels because of the repetition of intravenous insertion as well as toxicity of the chemotherapeutic agents.

Objective: To study the proper venipuncture sites for chemotherapy in cancer patients.

Materials and Methods: Using the Delphi technique, nine of the ten experts, with more than seven years of experience, volunteered to respond to the Likert rating questionnaires.

Results: All participants accomplished the study without procedure-related problems. Items concerning peripheral intravenous assessment on the dorsum of hand, forearm, antecubital fossa, and upper arm on the first, second, and third round were 58.3%, 58.3%, 58.3% and 48.3%; 71.6%, 71.6%, 73.3%, and 60.0%; 78.3%, 75.0%, 76.6%, and 65.0%, respectively.

Discussion: Veins located on the dorsum of hand were preferred in the first rank due to the facility to identify as well as to care, clean and control infection. This was followed by antecubital veins for its larger size, small risks of thrombophlebitis, and less irritation during chemotherapy, and veins at the forearm for its facilitating self-care management, as well as preventing dislodgement and occlusion.

Conclusion: The dorsum of hand followed by the antecubital fossa, forearm and upper arm of the non-dominant hand were the favorable sites of venipuncture for all cancer patients.

Keywords: Delphi Technique; Venipuncture sites; Chemotherapy

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Cancer is a life-threatening disease that medical personnel have been busy to investigate the cause for centuries. When patients have cancer, they must agree in the diagnosis and the treatment against the pain, the fear, the physical, and the emotional health consequences of the patients. Coping with the illness mean not only the radiation, the immunotherapy, the targeted therapy, the hormone treatment, and the surgery, but the renovation of cell therapies, the anti-tumor vaccines and the new biodiversity drugs have become the highly interesting issues[1,2]. By any means, the success of including the therapeutic agents into blood stream is the prime concern for a good survival rate and quality of life, particularly on occasional tumor recurrence. The intravenous catheterization normally performed to give these treatments is not an easy assignment in most cancer patients due to the abnormalities of the blood vessels[3].

An intravenous catheterization or a peripheral intravenous catheter (PIVC) are commonly used in hospitalized patients[3,4]. It is primarily applied for therapeutic purposes such as administration of medications, parenteral nutrition, fluids or blood products, as well as a blood sampling. To accomplish this minimal invasive procedure, a caregiver must follow the clinical practice guidelines for PIVC by using a small flexible plastic tube inserting through

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the skin into a patient's vein under aseptic technique. If there is no evidence of complications, it should be removed within three days[5].

Normally, a sequence of peripheral venous access on the non-dominant upper extremity is dorsum of hand, forearm, antecubital fossa, and upper arm[6]. However, a PIVC is not without adverse effects since patients' neovascularization are fragile in the environment of vesicant agents as extravasation and simply prone to infection because of immunosuppression[4]. The contributing factors of the PIVC failure are catheter occlusion, venous burst, large bore catheter, length of infusion, the chemotherapy regimen, and the site of venipuncture[3,7]. Meanwhile, nurses have noticeably quickened their pace of PIVC manipulation amongst oncologic patients. This could not only frustrate their efforts but also upsurge unsuccessful outcomes, resulting in inadvertent effects and patients' dissatisfaction[6].

The effectiveness of PIVC is not only a routine job, but it also needs skill for device usage, and venipuncture site selection[7]. Importantly, the Infusion Nurse Society (INS) suggested that a new access site for vesicant administration should be recorded to prevent repeated usage[8]. In addition, the site should last the expected time of prescribed fluid therapy, relieve pain, facilitate self-care, and prevent dislodge and occlusion[9].

Yet, the PIVC technique has been a highly controversial issue. Many studies tried to solve this matter by means of focus group discussion, Delphi technique, questionnaires, interviews, and observation. Nonetheless, focus group discussion is not easy to apply since all experts can play a decisive role in the debate over proposal. Additionally, questionnaires, interviews and observation are rather weak and indecisive. Accordingly, Delphi technique seems to be practical in terms of flexibility, opinion sharing, compromise, and agreement on statistically valid trial basis. As a result, the present study's investigators would like to use this technique on the PIVC study for the benefits of the oncology nurses at the forefront of screening unit.

Materials and Methods

After approval by the Human Research Ethics Committee, Chulabhorn Research Institute (No. 051/2561), the study was also registered in the Thai Clinical Trials Registry (TCTR 20181217002). The prospective study using Delphi technique was performed between May 2018 and March 2019 at the three tertiary hospitals in Bangkok.

Validation of the tests

The investigators reviewed textbooks, literature, previous studies on the existing nursery education, and the Clinical Nursing Practice Guidelines (CNPG) to design an open-ended questionnaire using a set of 60 Likert's scale, regarding opinions on venipuncture assessment. The questionnaires consisted of four parts, dorsum of hand (D), forearms (F), antecubital fossa (A), and upper arm (U). Three nurses with at least five years of experience verified the tool for content validity and objectivity with the index of item objective congruence (IOC) greater than 0.8. Consequently, the appropriateness of the test was established as a nurse competency guideline on venipuncture.

Delphi technique

This structured communication, systematic, interactive forecasting method relied on a panel of 10 experts including three physicians and seven nurses. The inclusion criteria were members having at least 10 years of experience in the designated field, willing to join the whole project without any honorarium and with the time available to respond to the queries by mail. Exclusion criterion were anyone who felt awkward and wanted to quit the study at any time.

Data collection

The specialists answered questionnaires in three rounds. After each round, a facilitator provided an unspecified summary of the participants' opinions from the previous round and reasons they provided for judgments. Additionally, they were encouraged to revise their earlier answers amidst the replies of other members. The process was stopped after completing a number of rounds.

The top two-box score was applied as cut-off point based on consensus to discard or maintain items regarding peripheral intravenous site assessment. If scores on the first and second round are 3 or less, those questions will be maintained for re-asking and clarifying with the experts. However, if no consensus is reached, the items will be passed to the third round. On the final round, the scores of 3 or less were discarded, while the scores of 4 or more were summarized for statistical analysis (Figure 1).

Statistical analysis

Data were expressed as medium, interquartile range (P25, P75) and percentage to analyze the data derived from the three rounds. Descriptive statistical consisting of medium and interquartile range was used

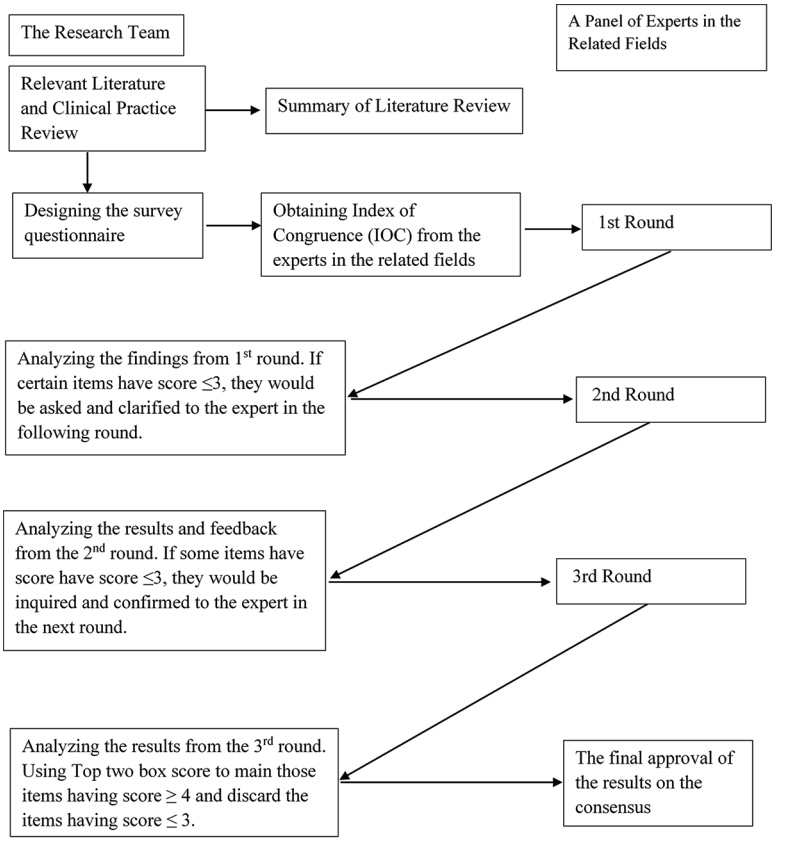

Figure 1. Schematic diagram.

to identify data distribution of the items between P25 and P75 based on agreement of a panel of experts. Regarding the consensus in the first and second round, a degree of agreement if the medium score of the items is more than 4, then the researcher will maintain those items by using the top two box score. On the other hand, if the medium score of the items is less than 4, then, those items will be sent back to the same expert to confirm their agreement.

Results

Ten participants accomplished the study without procedure-related problems. Participants' demographic characteristics were one male (10%) and nine females (90%), age 30 to 40 years for six participants (60%), and 50 years or older for four participants (40%), and with seven years of work experience for one respondent (10%), and over seven years for nine participants (90%) (Table 1).

Items concerning peripheral intravenous assessment on the dorsum of hand, forearms, antecubital fossa, and upper arm on the first, second and third round were 58.3%, 58.3%, 58.3% and 48.3%; 71.6%, 71.6%, 73.33%, and 60%; 78.33%, 75.0%, 76.6%, and 65%, respectively (Table 2, Figure 2).

Table 1. Demographic characteristics of participants

General information	n (%)
Sex	
Male	1 (10)
Female	9 (90)
Age; mean±SD	43.7±11.2
≤30 years	-
30 to 40 years	6 (60)
41 to 50 years	-
>50 or ≥51 years	4 (40)
Years of work experience; mean±SD	19.3±11.6
3 years	-
5 years	-
7 years	1 (10)
>7 years	9 (90)

SD=standard deviation

Table 2. Three consecutive rounds of queries regarding the appropriateness of venipuncture sites: dorsum of hand (D), forearm (F), ante-cubital fossa (A) and upper arm (U), including maintain (+) and discard (–) according to cut off point

Delphi	1st; median (IQR)				2nd; median (IQR)				3rd; median (IQR)			
Questionnaires	D	F	A	U	D	F	A	U	D	F	A	U
Part I: Intravenous cannulation assessment for chemotherapy												
1. Anatomical knowledge for intravenous cannulation assessment												
1.1 The following areas can be easily noticed.	5.0 (4.3,5.0)	3.5 (3.0,4.8)	4.0 (3.0,5.0)	3.0 (2.3,3.8)	5.0 (4.0,5.0)	4.0 (3.0,4.0)	4.0 (3.0,5.0)	3.0 (3.0,4.0)	+	+	+	–
1.2 Being the appropriate area for chemotherapy.	3.0 (2.0,5.0)	2.0 (2.0,4.0)	2.0 (1.3,3.8)	2.0 (1,2.3.0)	3.0 (2.0,4.3)	2.0 (1.8,3.3)	2.0 (2.0,3.0)	2.0 (1.0,4.0)	+	–	–	–
1.3 Arms with post-mastectomy, AV-Fistula for dialysis is considered as a proper area for venous cannulation.	1.0 (1.0,1.0)	1.0 (1.0,1.0)	1.0 (1.0,1.0)	1.0 (1.0,1.0)	1.0 (1.0,1.0)	1.0 (1.0,1.0)	1.0 (1.0,1.0)	1.0 (1.0,1.0)	–	–	–	–
1.4 This area is suitable for identifying metacarpal vein.	4.0 (1.8,5.0)	1.0 (1.0,3.0)	2.5 (1.0,3.0)	1.5 (1.0,3.0)	4.0 (2,4.5.0)	2.0 (1,3.5.0)	2.0 (1.0,3.0)	2.0 (1,2.5.0)	+	–	–	–
1.5 Inflammatory arms should be avoided for intravenous insertion	5.0 (4.25,5)	5.0 (4.25,5)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
1.6 Basilic or Cephalic vein is suitable for catheter insertion.	2.5 (2.0,4.0)	4.0 (2.2,5.0)	4.0 (3.0,4.0)	3.5 (1.5,4.0)	3.0 (2.0,4.0)	4.0 (4.0,5.0)	4.0 (3,4.3.0)	4.0 (3.0,4.0)	–	+	+	+
1.7 Arms opted for AV Shunt should be avoided.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
1.8 Veins located in the following areas should not be cannulated for many times.	3.5 (1.3,4.8)	4.0 (1.5,4.8)	4.0 (1.5,4.0)	3.5 (1.5,4.0)	4.0 (2.0,5.0)	4.0 (3.0,5.0)	4.0 (4.0,4.0)	4.0 (3.0,4.0)	+	+	+	+
1.9 Veins can be manipulated by small and large catheter.	3.0 (3.0,5.0)	4.5 (4.0,5.0)	4.0 (4.0,4.8)	4.5 (3.3,5.0)	3.0 (3.0,4.3)	4.0 (4.0,5.0)	4.0 (4.0,4.0)	4.0 (3.0,5.0)	+	+	+	+
1.10 Veins with clear visualization are not easily fragile.	4.5 (3.0,5.0)	4.5 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (3.0,5.0)	4.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	+	+	+	+
1.11 Veins are easy to insert catheter.	5.0 (5.0,5.0)	4.0 (3.3,5.0)	5.0 (3.3,5.0)	3.0 (3.0,4.8)	5.0 (5.0,5.0)	4.0 (3.0,5.0)	5.0 (4.0,5.0)	3.0 (3.0,5.0)	+	+	+	–
2. Complications of intravenous drug administration												
2.1 The following areas have risks of occlusion.	2.5 (1.3,3.8)	2.0 (1.0,3.0)	2.5 (2.0,3.0)	2.0 (2.0,3.0)	3.0 (1.0,4.0)	2.0 (1.0,2.0)	2.0 (2.0,3.0)	2.0 (2.0,3.0)	–	–	–	–
2.2 The following areas have risks of extravasation.	3.5 (2.3,4.0)	2.5 (2.0,3.0)	3.0 (2.0,3.0)	3.0 (2.0,3.0)	4.0 (3.0,4.0)	2.0 (2.0,3.0)	3.0 (3.0,4.0)	3.0 (3.0,3.0)	+	–	–	–
2.3 The following areas have risks of phlebitis.	3.5 (2.0,4.0)	2.0 (2.0,3.0)	3.0 (2.0,3.0)	3.0 (2.0,3.0)	4.0 (4.0,4.0)	2.0 (2.0,2.0)	4.0 (3.0,4.0)	3.0 (3.0,4.0)	+	–	+	–
2.4 The following areas have risks of dislodgement.	2.0 (1.3,3.8)	2.0 (2.0,2.8)	3.0 (2.3,4.0)	2.5 (2.0,3.0)	2.0 (1.0,3.0)	2.0 (2.0,2.0)	3.0 (3.0,4.0)	2.0 (2.0,3.0)	+	–	+	–
2.5 The following areas have risks of septicemia.	2.0 (1.3,2.8)	2.5 (1.3,3.0)	2.5 (2.0,3.0)	2.5 (2.0,3.0)	2.0 (1.0,2.0)	2.0 (2.0,3.0)	3.0 (2.0,3.0)	3.0 (2.0,4.0)	–	–	–	–
3. Patient preparation												
3.1 To introduce staffs' name and title and identify patients prior to cannula insertion	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.2 To educate and response patients in details about the process to relief their anxiety.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.3 To notify patients regarding signs of extravasation such as pain and edema during chemo administration.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.4 To assess a mobility of a designated area before intravenous cannulation.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.5 To wash your hand before and after intravenous drug administration.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.6 To keep warm on the designated areas.	4.0 (3.0,4.8)	3.0 (2.3,4.8)	3.5 (2.3,4.0)	3.0 (2.3,4.0)	4.0 (3.0,5.0)	4.0 (3.0,5.0)	4.0 (3.0,4.0)	4.0 (3.0,4.0)	+	+	+	+
3.7 To place patient in a good position where gravity makes veins are obviously seen.	4.5 (4.0,5.0)	4.0 (3.3,4.8)	4.0 (3.3,4.8)	4.0 (3.0,4.0)	4.0 (4.0,5.0)	4.0 (3.0,4.0)	4.0 (3.0,4.0)	4.0 (3.0,4.0)	+	+	+	+
3.8 Staffs should place themselves in a sitting position to reduce back pain during cannula insertion.	4.5 (3.3,5.0)	4.5 (3.0,5.0)	4.0 (3.3,5.0)	4.0 (3.3,5.0)	4.0 (4.0,5.0)	4.0 (3.0,5.0)	4.0 (4.0,5.0)	4.0 (4.0,5.0)	+	+	+	+
3.9 To select veins on the other arm if it fails on the first one.	5.0 (4.0,5.0)	4.5 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	4.5 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	+	+	+	+
3.10 To put gloves on before cannula insertion.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.11 To clean the designated area with alcohol wrap which makes veins are obviously seen.	3.5 (3.0,4.8)	4.0 (3.0,5.0)	4.5 (3.0,5.0)	4.5 (3.0,5.0)	4.0 (3.0,5.0)	4.5 (3.8,5.0)	5.0 (3.0,5.0)	5.0 (3.0,5.0)	+	+	+	+
3.12 To place the tourniquet above the designated area about 2-3 inches. Blood pressure cuff can be applied as the tourniquet in the elderly.	3.0 (2.3,4.0)	3.5 (2.0,4.0)	4.5 (3.0,5.0)	3.0 (3.0,5.0)	3.0 (2.0,4.0)	3.0 (2.0,4.0)	4.0 (3.0,5.0)	3.0 (3.0,5.0)	+	+	+	+
3.13 To use distraction strategies such as giving a small talk during cannula insertion.	4.5 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.3,5.0)	5.0 (4.3,5.0)	4.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	+	+	+	+
3.14 To prioritize a non-dominant and retract the skin before catheter insertion.	5.0 (5.0,5.0)	5.0 (2.5,5.0)	5.0 (4.3,5.0)	5.0 (4.3,5.0)	5.0 (5.0,5.0)	5.0 (2.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	+	+	+	+
3.15 To apply Tegaderm or a sterile transparent on the cannulation site.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+

IQR=interquartile range

Table 2. (continued)

Delphi	1st; median (IQR)				2nd; median (IQR)				3rd; median (IQR)			
Questionnaires	D	F	A	U	D	F	A	U	D	F	A	U
Part II: Patient and procedure associated with risk factors												
1. Characteristics of target veins												
1.1 Small and fragile veins are in the following areas.	3.5 (2.0,4.0)	2.0 (2.0,3.0)	1.0 (1.0,2.8)	2.0 (1.0,2.0)	4.0 (4.0,4.0)	2.0 (2.0,3.0)	1.0 (1.0,3.0)	2.0 (1.0,2.0)	+	–	–	–
1.2 Veins have hardness and stenosis due to receiving several circles of chemotherapy.	5.0 (3.3,5.0)	3.0 (2.3,3.8)	3.0 (2.0,3.0)	2.5 (2.0,3.0)	5.0 (4.0,5.0)	4.0 (3.0,4.0)	3.0 (3.0,4.0)	2.0 (2.0,3.0)	+	+	–	–
1.3 Veins have hardness and stenosis due to drug abuse or drug addiction.	4.0 (3.0,5.0)	3.0 (2.3,4.0)	2.5 (1.3,4.0)	2.0 (2.0,4.0)	4.0 (3.0,5.0)	4.0 (3.0,4.0)	2.0 (1.0,4.0)	2.0 (2.0,4.0)	+	+	–	–
1.4 The prominent veins are commonly observed.	3.0 (2.0,3.0)	2.5 (2.0,3.0)	2.0 (1.0,3.0)	2.0 (1.3,2.0)	3.5 (3.0,4.0)	2.0 (2.0,3.0)	2.0 (1.0,2.0)	2.0 (1.0,2.0)	–	–	–	–
2. Vascular disease such as Raynaud syndrome, advanced diabetic mellitus, and hypertension												
2.1 To effect on veins in terms of tonicity.	4.0 (3.3,5.0)	3.5 (2.3,5.0)	2.5 (2.0,5.0)	2.5 (2.0,5.0)	4.0 (4.0,5.0)	4.0 (4.0,5.0)	2.0 (2.0,5.0)	2.0 (2.0,5.0)	+	+	–	–
2.2 To effect on veins concerning vascular permeability.	4.0 (3.0,4.8)	2.5 (2.0,4.5)	2.5 (2.0,3.0)	2.5 (2.0,3.8)	4.0 (3.0,5.0)	2.0 (2.0,4.0)	2.0 (2.0,3.0)	2.0 (2.0,4.0)	+	–	–	–
2.3 To have more Body Mass Index (BMI) than the standard.	3.5 (2.3,4.8)	3.5 (2.3,4.8)	3.0 (2.3,4.0)	2.0 (3.0,4.0)	4.0 (3.0,4.0)	4.0 (3.0,4.0)	3.0 (3.0,4.0)	2.0 (3.0,4.0)	+	+	–	–
2.4 To gain experience in numbness on veins.	3.0 (3.0,4.8)	3.0 (2.0,3.0)	3.0 (2.0,3.8)	3.0 (2.0,3.0)	3.0 (3.0,4.0)	3.0 (2.0,3.0)	4.0 (3.0,4.0)	3.0 (2.0,3.0)	+	–	+	–
2.5 To avoid infusing chemo drug continuously on the same area.	4.0 (4.0,5.0)	3.0 (3.0,4.0)	5.0 (3.5,5.0)	5.0 (3.3,5.0)	4.0 (4.0,5.0)	4.0 (3.0,4.0)	5.0 (4.0,5.0)	5.0 (3.0,5.0)	+	+	+	+
3. Communication challenges to notify nurses when patients experience signs of extravasation												
3.1 Veins located on the following areas are easily identified by patients.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
Part III: Cannulation and infusion procedure related												
1. Knowledge of cannula insertion procedure												
1.1 Venipuncture sites on the following area are easy to care and clean.	5.0 (5.0,5.0)	4.0 (4.0,5.0)	5.0 (4.3,5.0)	4.0 (4.0,5.0)	5.0 (5.0,5.0)	4.0 (4.0,5.0)	5.0 (4.0,5.0)	4.0 (4.0,4.0)	+	+	+	+
1.2 Sites of insertion be easily cleaned.	5.0 (5.0,5.0)	4.5 (3.3,5.0)	5.0 (5.0,5.0)	5.0 (4.3,5.0)	5.0 (5.0,5.0)	4.0 (3.0,5.0)	5.0 (5.0,5.0)	5.0 (4.0,5.0)	+	+	+	+
1.3 Sites of insertion can be controlled in terms of infection	5.0 (4.3,5.0)	5.0 (4.0,5.0)	4.5 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	4.0 (4.0,5.0)	4.0 (3.0,5.0)	+	+	+	+
1.4 Sites of insertion can be easily strapped.	5.0 (5.0,5.0)	5.0 (4.0,5.0)	3.5 (2.0,5.0)	4.0 (4.0,4.8)	5.0 (5.0,5.0)	5.0 (4.0,5.0)	4.0 (3.0,5.0)	4.0 (4.0,4.0)	+	+	+	+
2. Years of working experience												
2.1 Veins on the following area are prone to have several attempts for cannulation insertion. (>1 attempt)	3.5 (2.3,4.8)	4.0 (3.0,5.0)	4.0 (2.3,4.8)	4.0 (4.0,4.8)	4.0 (4.0,5.0)	4.0 (4.0,5.0)	4.0 (4.0,4.0)	4.0 (4.0,4.0)	+	+	+	+
2.2 Veins on the following areas are required for skilled personnel to insert catheter.	4.0 (2.3,4.0)	4.0 (2.5,5.0)	3.5 (2.3,4.0)	4.0 (3.0,4.0)	4.0 (4.0,4.0)	4.0 (4.0,5.0)	4.0 (3.0,4.0)	4.0 (3.0,4.0)	+	+	+	+
2.3 Veins on the following area are suitable for high dosage of chemo drug for every time.	2.0 (2.0,4.5)	4.0 (3.2,4.0)	3.0 (2.0,4.0)	3.0 (2.3,4.0)	2.0 (2.0,4.0)	4.0 (3.0,4.0)	4.0 (2.0,4.0)	4.0 (3.0,4.0)	–	+	+	+
2.4 Veins on the following area are appropriate for high pressure during drug administration	2.0 (2.0,5.0)	3.5 (3.0,4.0)	2.0 (1.8,4.0)	3.0 (2.5,3.5)	2.0 (2.0,3.0)	3.5 (3.0,4.0)	2.0 (1.5,4.0)	3.0 (2.5,3.5)	–	–	–	–
2.5 Veins on the following area are proper for high concentrated, intravenous drug administration.	2.0 (1.3,2.8)	4.0 (3.3,5.0)	3.0 (2.0,4.0)	3.5 (3.0,4.0)	2.0 (1.0,2.0)	4.0 (4.0,5.0)	4.0 (2.0,4.0)	4.0 (3.0,4.0)	–	+	+	+
2.6 To wash hands before and after intravenous insertion is necessary.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
2.7 To put gloves before and after intravenous insertion is required.	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
2.8 Veins on the following area are easily to identify due to a large size.	5.0 (4.0,5.0)	4.0 (3.0,5.0)	4.0 (3.3,4.8)	3.5 (2.0,4.0)	4.0 (4.0,5.0)	4.0 (4.0,5.0)	4.0 (4.0,5.0)	4.0 (4.0,4.0)	+	+	+	+
3. Device required for cannula insertion												
3.1 All size catheter can be applied for intravenous cannulation.	5.0 (4.8,5.0)	5.0 (4.8,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.2 To choose an appropriate catheter to suit the venous site.	5.0 (4.8,5.0)	5.0 (4.8,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	+	+	+	+
3.3 A large bore catheter is hardly to be occluded.	3.0 (2.0,4.0)	3.0 (2.0,4.0)	3.0 (2.3,4.0)	3.0 (2.3,4.0)	4.0 (3.0,4.0)	3.0 (2.0,4.0)	4.0 (3.0,4.0)	4.0 (4.0,4.0)	+	–	+	+
3.4 A large bore or long catheter increases the risk for phlebitis.	3.0 (2.0,5.0)	3.0 (2.0,5.0)	4.0 (3.3,4.8)	4.0 (3.3,4.8)	3.0 (3.0,4.0)	3.0 (3.0,4.0)	4.0 (3.0,4.0)	3.5 (2.5,4.3)	–	–	+	+
3.5 A long catheter helps to reduce perivascular leakage.	3.0 (2.0,3.0)	3.0 (2.0,3.0)	3.0 (1.0,4.0)	3.0 (1.0,4.0)	2.0 (2.0,2.0)	2.0 (1.0,3.0)	2.0 (1.0,2.0)	2.0 (1.0,3.0)	–	–	+	+
3.6 To use stainless or butterfly catheter is proper for veins on the following area.	2.0 (1.0,3.0)	1.0 (1.0,3.0)	2.0 (1.0,2.0)	1.5 (1.0,2.8)	2.0 (2.0,4.0)	4.0 (2.0,4.0)	4.0 (2.0,4.0)	3.0 (2.0,4.0)	–	–	–	–
3.7 Arm stabilization is necessary to reduce its movement.	2.0 (2.0,5.0)	3.0 (2.0,5.0)	4.0 (2.0,4.8)	3.0 (2.0,4.0)	5.0 (5.0,5.0)	5.0 (5.0,5.0)	5.0 (4.0,5.0)	5.0 (4.0,5.0)	–	+	+	–

IQR=interquartile range

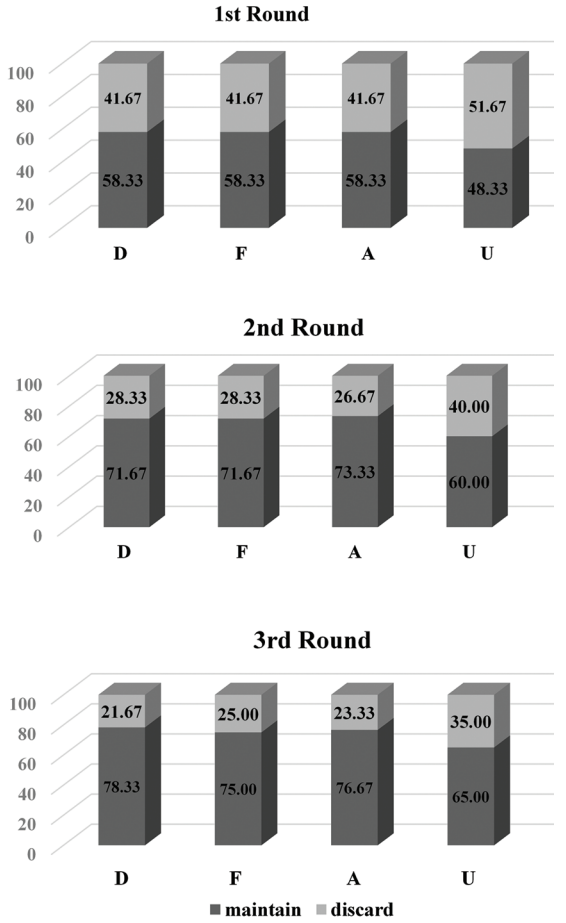

Figure 2. Items concerning peripheral intravenous assessment on the dorsum of hand (D), forearms (F), antecubital fossa (A), and upper arm (U) on the first, second and third round.

Most participants reached a consensus on the dorsum of hand for easy approach, with notice and identify venous site, insert and use appropriate catheter as well as care, clean and control infection. Regarding the veins in the antecubital area, they agreed that large bore catheters can be simply applied as compared to the other sites.

Discussion

All participants reached a consensus on the dorsum of the hand for some reasons. It was easy to notice and identify venous site for venipuncture and insertion with an appropriate catheter as well as to care, clean, and control infection. However, they also agreed that large bore needles can be simply applied as compared to the other sites.

This was not beyond the investigators' expectations. Normally, the superficial veins lying within the subcutaneous tissue arise from the dorsal venous arch on the dorsum of the hand. Though they contain valves in the lumen, they do not hold as much muscle in their walls as arteries. The valves and the lesser amount of muscle in the veins allow them to expand and act as a reservoir for blood. In addition, the valves are designed to prevent the backflow of venous blood which drain against gravity. As a result, the venous sites on the dorsum of the hand are easy to approach in clinical practice.

This agreed with the guideline on PIVC sponsored by the Department of Health, Queensland, Australia (2018). It stated that the dorsum of hand was the easiest to visualize[5]. Tan et al (2016) in a randomized trial on peripheral intravenous catheterization in obstetric patients in the hand or forearm vein also found that insertion of a catheter into the back of hand was more likely to be successful at the first attempt and concluded that both insertion sites were suitable. However, the back of the hand vein might be easier to cannulate and seemed to be preferred by the frontline providers[10]. Similarly, Wallis et al (2014) reported that the metacarpal veins on the dorsum site were stress-free to notice for PIVC[11].

However, Cicolini et al (2014) in a multi-center prospective field study evaluated whether peripheral venous catheter site insertion influences the risk of catheter related phlebitis. They claimed that the dorsum veins of hand had a higher risk of phlebitis than the antecubital fossa or forearm veins[5]. Wallis et al (2014) in a multivariate analysis of data from a randomized controlled trial on risk factors for PIVC failure confirmed that PIVCs placed into the hand had significantly higher rate of occlusion compared with forearm[11]. Nevertheless, Gorski et al (2016) in an article on infusion therapy standards of practice stated that short peripheral catheter placement in the hand was most likely to last the full duration of the infusion therapy owing to decrease pain during dwell time, promote self-care, as well as prevent accidental removal and occlusions[12].

Regarding veins located on antecubital fossa, Dougherty et al (2002) in delivery of intravenous therapy presented that it was recommended due to a larger size[7]. In addition, Cicolini et al (2014) in an observational study on position of peripheral venous cannula and the incidence of thrombophlebitis reported that selecting veins on the antecubital fossa should be encouraged to minimize risks of thrombophlebitis and lower risks of phlebitis[5]. Likewise, Sait et al (2019) in an observational study on intravenous site complications for patients receiving chemotherapy revealed that cancer patients

receiving chemotherapy in antecubital fossa site experienced less pain and irritation during infusing chemotherapy drug[3].

However, Trinh et al (2011) in a study on peripheral venous catheter-related staphylococcus aureus bacteremia represented that inserting PIVC into antecubital fossa had certain concerns regarding higher risks of infection due to flexibility and mobility[13]. Additionally, Wallis et al (2014) in a multivariate analysis of data from a randomized controlled trial on risk factors for peripheral intravenous failure confirmed that PIVC placed into antecubital fossa had a higher possibility of accidental removal compared to the forearm[11]. Gorski et al (2017) in a selection on peripheral venous access via short peripheral catheters traditional practice further confirmed that inserting PIVC into the antecubital fossa showed higher risk of phlebitis[12].

Apart from this part, Alexandrou et al (2018) in a cross-sectional study on use of short PIVCs: characteristics, management, and outcomes worldwide, indicated that the vein situated on forearm area was a proper site for PIVC placement in adults instead of higher flexion areas since it was beneficial in terms of a wide skin surface to secure and dressing at the site[14]. In addition, the guideline by the Department of Health, Queensland, Australia (2015) recommended that veins situated in forearm had lower risks of phlebitis[6]. The relevant article by Gorski et al (2016) further insisted that using forearm veins improved increasing dwelling time, minimizing pain during infusion, enhancing selfcare, and preventing dislodgement and occlusion[12].

Nevertheless, Alexandrou et al (2018) also stated that the forearm vein had some disadvantage when the inexperienced frontline providers had to place the catheter into this area. Thus, cause pain and dissatisfaction from the patients due to sensitive skin[14].

Limitation

There were some limitations in the present study. This project was conducted at a single center. Additionally, a greater number of experts in any fields other than anesthetists and nurse practitioners were needed to cover all clinical aspects of peripheral intravenous cannulation.

Conclusion

Vein located on the dorsum of hand was preferred owing to the facility to notice and identify as well as to care, clean, and control infection. The antecubital area was revealed as the second position with its advantages in terms of larger size of veins, minimize risks of thrombophlebitis, lower risks of phlebitis, and less pain and irritation during drug administration. Last of all, vein at the forearm had a wide skin surface to secure and clean, lower risks of phlebitis, prolong dwelling time, facilitating self-care management, preventing dislodgement and occlusion.

What is already known on this topic?

The peripheral intravenous cannulation has been suggested to perform on the dorsum of the non-dominant hand of patients either receiving fluid administration or chemotherapy. In addition, the area of wrist joint as well as the side of breast surgery, axillary node dissection or arterio-venous fistula should be avoided owing to some adverse events such as nerve damage and pain.

What this study adds?

The present study revealed that the dorsum of hand followed by the antecubital fossa, forearm and upper arm of the non-dominant hand were the favorable sites of venipuncture for all patients. For patients receiving chemotherapy, however, their condition, several drug administration cycles, and working experience of attending practitioners were crucial to accomplish on this matter.

Conflicts of interest

The authors declare no conflict of interest.

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