

# The Most Effective Ways to Overcome Difficult Intra-Venous Cannulation in King Abdulaziz Medical City in Riyadh.

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**Abstract- Introduction:** An Intravenous cannula is a catheter punctured through the skin till it reaches the vein to provide access to administer fluids, drugs, and blood through the vein. Intravenous cannulation is challenging in many patients, where healthcare providers struggle to achieve a successful intravenous cannulation. Intravenous access is essential in everyday jobs in the hospital. Difficult IV cannulation could cause patient discomfort or sometimes death. Multiple attempts will result in patient discomfort and narrow your options for other sites. **Methods:** One hundred hospital staff members were included in the study. It includes anesthesia technicians, nurses, and Phlebotomists. The sample size was calculated according to the population and 95% confidence interval, and the margin of error is 5%. We investigated the most difficult patients to perform IV cannulation, the number of attempts to perform successful IV cannulation, and the techniques to overcome difficult IV cannulation. **Results:** Among 123 participants, most were nurses (82%) and female (82%), with 61% having more than five years of experience. Obese patients were identified as the most difficult to cannulate (72.7%), followed by chemotherapy patients (41%) and those with sickle cell anemia (5.8%). About 62.2% required two attempts to achieve successful IV cannulation. Phlebotomists most frequently performed cannulation multiple times daily (87%). More than half (55.9%) sought help from expert colleagues when facing difficult cases. Locating a suitable vein was the most challenging task (53.5%). Only 26% had used an assistive device, with training deficits (66.6%) being the primary barrier to use. **Conclusion:** Intravenous access is essential in every day job in the hospital. Difficult IV cannulation could cause patient discomfort or sometimes death. Multiple attempts will result in patient discomfort and will narrow your options for other sites.

**Indexed Terms-** Intravenous Cannulation; Difficult IV Access; Vascular Access; Anesthesia Technology; Emergency Nursing

## I. INTRODUCTION

An intravenous cannula is a catheter punctured through the skin till it reaches the vein to provide access to administer fluids, drugs, and blood through the vein. Intravenous cannulation is challenging in many patients, where healthcare providers struggle to achieve a successful intravenous cannulation.

Difficult intravenous (IV) access is defined as multiple attempts and/or the anticipation of special interventions being required to establish and maintain peripheral venous access. Predictive factors for difficult IV access include edema, obesity, and a history of IV drug use. [1]

## II. REVIEW OF LITERATURE

While the literature regarding factors associated with difficult IV access in adults is limited. It is further noted that venous cannulation at the hands of a more experienced emergency care provider was associated with an increased success rate. Smaller caliber IV catheters were more commonly associated with cannulation failure. This finding was postulated to be due to the choice of the person inserting the IV catheter and the anticipated ease or difficulty of insertion. [2] An intravenous cannula is a catheter punctured through the skin till it reaches the vein to provide access to administer fluids, drugs, and blood through the vein. Intravenous cannulation is challenging in many patients, where healthcare providers struggle to achieve a successful intravenous cannulation. Failed IV insertions are mainly attributed to vein characteristics as described by Jacobson, who listed 12 factors contributing to the difficulty of IV insertion: vein difficult to thread, overall poor veins, vein “disappearance” invisible vein, rolling vein, IV

infiltration, vein difficult to puncture, dark skin, arm obese, tough skin, and patient movement. [2] Patient characteristics are also factors, as described by Gregg et al. [3]. Eventually, the nurse's experience and the emergency context can explain some difficulties in catheter insertion. Success rate and time to vascular cannulation are crucial to the optimal resuscitation of a critically ill patient.

This can be challenging even for the most experienced emergency nurse. One of the alternative approaches to achieve cannulation in the patient with difficult venous access is central venous catheterization (CVC). CVC cannulation is a reliable source of vascular access in fluid resuscitation, and further, it is capable of hemodynamic monitoring.

However, CVC cannulation presents additional risks to the patient. The most common among these complications are venous thrombosis, arterial puncture, catheter-associated bloodstream infection, and pneumothorax. Given the time required to establish a central venous catheter, the increased risk to the patient, and the skill required of the provider, other alternatives for vascular access are often desirable. [4]

Ultrasound-guided venipuncture is an established technique for both peripherally inserted catheters and central venous cannulation. [5] It has been suggested that, with the increasing availability of portable ultrasound facilities, this may become an option in the future for difficult peripheral intravenous cannulation. [6] Ultrasound is considered to be one of the most effective techniques in intravenous cannulation. This was confirmed by a study conducted by the American College of Emergency Physicians confirms that the use of ultrasound was successful in 91 patients (91%) and accomplished on the first attempt in 73 (73%).[7]

### III. MATERIALS AND METHODS

The study aims to investigate the most effective method to overcome the difficulties in intravenous cannulation in King Abdul-Aziz Medical City in the National Guard.

Inclusion criteria were Anesthesia technicians, Nurses, and Phlebotomists working at King Abdulaziz

Medical City. Exclusion criteria were a Medical intern at King Abdulaziz Medical City.

One hundred hospital staff were included in the study. It includes anesthesia technicians, nurses, and Phlebotomists. The sample size was calculated according to the population and 95% confidence interval, and the margin of error is 5%

Study subjects were assigned consecutively in the study. A self-written data collection sheet was used in this study. Variables in this study: Gender, Qualification degree, Position. Experience period, Neurological problem, Type of patient with difficult IV cannulation, Effect of cannulation size, Number of attempts for IV cannulation, Frequency of requiring IV cannulation, Facing difficult IV cannulation, Technique to overcome difficult IV, Hardest part in performing IV cannulation, Using device to overcome difficult IV. Type of device used, most important features for the device that assist with IV, and Obstacles regarding introducing a new device. Descriptive analysis was used to evaluate the study variables. Crosstabulation was applied to different variables in the study. The chi-square test was used to compare different study groups. SPSS v. 22 was used for statistical analysis. Departmental approval and Institutional Review Board Approval from King Abdullah International Medical Research Center (KAIMRC) were sought before the initiation of the study. The confidentiality and anonymity of the respondents in the study were maintained.

Originally, our sample size was one hundred, but we have investigated 123 of the hospital staff in the concerned departments, to have better results and to compensate for any missing data.

### IV. RESULT

The study population (123 individuals) was categorized into different groups according to occupational status. This group included nurses (n=101), anesthesia technicians (n=14), and phlebotomists (n=8).

82% of the study population was female. (Table1). The majority of the population were nurses 82 % (n=101), while Anesthesia technicians 11 % (n=14),

and phlebotomists were 6.5 % (n=8) (Table 2). Table 3 shows the different degrees of experience. Among the population, 61% have more than five years of experience, and only 4.9% have less than one year of experience.

According to the study results, the obese were the most difficult to cannulate in IV cannulation, 72.7%. And the chemotherapy patient came in second at 41%. And sickle cell anemia patients came in last, 5.8%. (Table 4)

According to the study result, 62.2% of the study population takes the theme two attempts to perform IV cannulation, and only 8% take the theme one attempt. (Table 5)

The most frequently required staff to perform IV cannulation multiple times a day was a phlebotomist (87%). whereas 71% of the anesthesia technicians perform IV cannulation multiple times a day. 37% of the nurses perform IV cannulation multiple times a day. (table6)

According to the study result, 55.9% of the study population seek help from an expert colleague when facing difficult patients, whereas 44.1% attempt insertion in different locations, and only 17.1% keep trying until inserted correctly. (table7)

Among the study population, 53.5% considered locating a suitable vein as the hardest part in performing IV cannulation. While correctly penetrating the vein with a needle is the second hardest, 26.8%. And only 21.1% consider pushing the needle upstream without puncturing the vein as the hardest part. (Table 8)

Only 26% of the study population has used an assistive device. (19.5%) prefer using veinlite. While 6.5% prefer Accuvein. (Table 9, 10)

Obstacles that prevent the participants from using a new device to assist in IV cannulation, (66.6%) of the study population lack training, which prevents them from using a new device. Whereas (23%) see that if the device is too complicated, it will prevent them from using it. (16%) Some of the study population

chose that if the device is impractical, this will prevent them from using it. (Table 11)

## V. DISCUSSION

In our study, we distributed a self-written questionnaire to healthcare providers who regularly perform IV cannulation. To obtain more accurate answers, our population consists of nurses, anesthesia technicians, and phlebotomists with varying experience periods.

According to a study published in Annals of Emergency Medicine, to evaluate the effectiveness of ultrasound in IV cannulation. [7] Obese patients and chemotherapy patients were considered difficult patients. In our study, the majority chose obese patients as the most difficult patients. Obese individuals are considered difficult because of a large amount of fat blocking the view of the veins. And chemotherapy patients came in second. Patients undergoing chemotherapy are difficult because the chemotherapy affects the veins when administered. Then the children came after that. Elderly and burned patients were chosen equally. Then, after that, patients with special needs. Children and patients with special needs are difficult because they are difficult to hold down when performing IV cannulation. In all the studies in the literature review, a patient is considered difficult after two failed attempts. In our study, the majority of the population takes two attempts to perform IV cannulation. How would you normally overcome difficulties with an IV cannula in the first few attempts? The majority of the participants chose that seeking help from an expert college is a better option. Keep trying until inserted correctly was the lowest option. This causes many issues. First, it will cause patients discomfort. Second, it takes a lot of time if repeated too many times. Attempt insertion in different locations. Repeating an attempt and trying a different location will initially lower the options. An assisting device could be used in situations where the veins are unclear. In regard to the hardest part in performing IV cannulation, the majority of the population chose locating suitable veins as the hardest part in performing IV cannulation. Locating a suitable vein is challenging, especially in difficult patients. And if the cannula size is big, then it will be more challenging to find a vein that can accommodate the

big cannula. Failed IV insertions are mainly attributed to vein characteristics as described by Jacobson, who listed 12 factors contributing to the difficulty of IV insertion: a vein difficult to thread, overall poor veins, and a “disappearance” invisible vein. [3] In regard to using, a study published in Pediatric Emergency Care reported that the use of Veinlite was associated with a higher success rate. [10] But the majority of the participants never used an IV assisting device, and when asked about the obstacles that prevent them from using the devices. The majority chose a lack of training. According to a study published in the Journal of Vascular Access, one of the obstacles in using an assisting device to perform IV cannulation is the different levels of training. [9]

### VI. LIMITATIONS

In our questionnaire form, there were two questions with a lot of missing data, so we have excluded them.

### VII. CONCLUSION

Intravenous access is essential in a day job in the hospital. Difficult IV cannulation, if not addressed properly, could cause patient discomfort or sometimes death. Multiple attempts will result in patient discomfort and will narrow your options for other sites. Obese patients have difficult IV access. If a patient is too difficult, seeking help from an expert colleague or using an IV assisting device will help.

### REFERENCES

[1] Acosta S. The use of ultrasound for placement of intravenous catheters. UNIFORMED SERVICES UNIV OF THE HEALTH SCIENCES BETHESDA, MD; 2004

[2] Bair AE, Rose JS, Vance CW, Andrada-Brown E, Kuppermann N. Ultrasound-assisted peripheral venous access in young children: a randomized controlled trial and pilot feasibility study. *Western Journal of Emergency Medicine*. 2008;9:219.

[3] Jacobson AF. Intradermal normal saline solution, self-selected music, and insertion difficulty effects on intravenous insertion pain. *Heart & Lung: The Journal of Acute and Critical Care*. 1999; 28:114-22.

[4] Gregg SC, Murthi SB, Sisley AC, Stein DM, Scalea TM. Ultrasound-guided peripheral intravenous access in the intensive care unit. *Journal of Critical Care*. 2010; 25:514-9

[5] Keenan SP. Use of ultrasound to place central lines. *Journal of Critical Care*. 2002 ;17:126-37

[6] Mbamalu D, Banerjee A. Methods of obtaining peripheral venous access in difficult situations. *Postgraduate medical journal*. 1999 ;75:459-62

[7] Keyes LE, Frazee BW, Snoey ER, Simon BC, Christy D. Ultrasound-guided brachial and basilic vein cannulation in emergency department patients with difficult intravenous access. *Annals of Emergency Medicine*. 1999 ;34:711-4

[8] Stolz, Lori A , Stolz, Uwe , Howe, Carol , Farrell, Isaac J , Adhikari, Srikar. Ultrasound-guided peripheral venous access: a meta-analysis and systematic review. *The journal of vascular access* 2015;16:4 259-346

[9] Katsogridakis, Y. L., Seshadri, R., Sullivan, C, Waltzman, M. L. Veinlite transillumination in the pediatric emergency department: a therapeutic interventional trial. *Pediatric emergency care* 2008; 24:2 83-88

[10] Stein, John, et al. "Ultrasonographically guided peripheral intravenous cannulation in emergency department patients with difficult intravenous access: a randomized trial." *Annals of emergency medicine* 54.1 2009: 33-40.

Table 1: Gender specification

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
male	21	17.1	17.1	17.1
female	102	82.9	82.9	100.0
Total	123	100.0	100.0	

Table 2: Occupation

	Frequency	Percent	Valid Percent	Cumulative Percent
Nurse	101	82.1	82.1	82.1
Anesthesia Technician	14	11.4	11.4	93.5
Phlebotomist	8	6.5	6.5	100.0
Total	123	100.0	100.0	

Table 3: Experience period

	Frequency	Percent	Valid Percent	Cumulative Percent
<1year	6	4.9	4.9	4.9
1-3years	16	13.0	13.0	17.9
3-5years	25	20.3	20.3	38.2
>5years	76	61.8	61.8	100.0
Total	123	100.0	100.0	

Table 4: Most Difficult Patient

		children	obese	Patients with special needs	elderlies	Burned patients	Patients under chemotherapy	Sickle cell anemia patients	total
nurse	Count	37	81	18	37	30	38	5	100
	% within Occupation	37.0%	81.0%	18.0%	37.0%	30.0%	38.0%	5.0%	
	% of Total	30.6%	66.9%	14.9%	30.6%	24.8%	31.4%	4.1%	82.6%
anesthesia technician	Count	4	6	4	1	7	8	2	13
	% within Occupation	30.8%	46.2%	30.8%	7.7%	53.8%	61.5%	15.4%	
	% of Total	3.3%	5.0%	3.3%	0.8%	5.8%	6.6%	1.7%	10.7%
phlebotomist	Count	2	1	4	0	1	4	0	8
	% within Occupation	25.0%	12.5%	50.0%	0.0%	12.5%	50.0%	0.0%	
	% of Total	1.7%	0.8%	3.3%	0.0%	0.8%	3.3%	0.0%	6.6%
total	Count	43	88	26	38	38	50	7	121
	% of Total	35.5%	72.7%	21.5%	31.4%	31.4%	41.3%	5.8%	100.0%

Table 5: Number of attempts to perform IV cannulation

		Only once	Two	Three	More	total
Nurse	Count	7	63	20	11	101
	% within Occupation	6.9%	62.4%	19.8%	10.9%	100.0%
Anesthesia Technician	Count	3	8	1	2	14
	% within Occupation	21.4%	57.1%	7.1%	14.3%	100.0%
Phlebotomist	Count	0	6	1	1	8
	% within Occupation	0.0%	75.0%	12.5%	12.5%	100.0%
Total	Count	10	77	22	14	123
	% within Occupation	8.1%	62.6%	17.9%	11.4%	100.0%

Table 6: Frequency of requiring IV cannulation

		Multiple times a day	Once a day	Once a week	Twice a week	as needed	total
Nurse	Count	38	15	10	24	14	101
	% within Occupation	37.6%	14.9%	9.9%	23.8%	13.9%	100.0%
Anesthesia Technician	Count	10	1	1	1	1	14
	% within Occupation	71.4%	7.1%	7.1%	7.1%	7.1%	100.0%
Phlebotomist	Count	7	1	0	0	0	8
	% within Occupation	87.5%	12.5%	0.0%	0.0%	0.0%	100.0%
Total	Count	55	17	11	25	15	123
	% within Occupation	44.7%	13.8%	8.9%	20.3%	12.2%	100.0%

Table 7: Technique to overcome difficult IV

		Keep trying until inserted correctly	Attempt insertion in a different location	Seek help from an expert colleague	Use some sort of assisting device	total
Nurse	Count	15	39	54	14	91
	% within Occupation	16.5%	42.9%	59.3%	15.4%	
	% of Total	13.5%	35.1%	48.6%	12.6%	82.0%
Anesthesia Technician	Count	4	5	6	7	13
	% within Occupation	30.8%	38.5%	46.2%	53.8%	

	% of Total	3.6%	4.5%	5.4%	6.3%	11.7%
Phlebotomist	Count	0	5	2	1	7
	% within Occupation	0.0%	71.4%	28.6%	14.3%	
	% of Total	0.0%	4.5%	1.8%	0.9%	6.3%
Total	Count	19	49	62	22	111
	% of Total	17.1%	44.1%	55.9%	19.8%	100.0%

Table 8: Hardest part in performing IV cannulation

		Locating suitable vein	Correctly penetrating vein with needle	Pushing needle upstream without puncturing the vein	total
Nurse	Count	54	25	22	101
	% within Occupation	53.5%	24.8%	21.8%	100.0%
Anesthesia Technician	Count	5	6	3	14
	% within Occupation	35.7%	42.9%	21.4%	100.0%
Phlebotomist	Count	5	2	1	8
	% within Occupation	62.5%	25.0%	12.5%	100.0%
Total	Count	64	33	26	123
	% within Occupation	52.0%	26.8%	21.1%	100.0%

Table 9: Using device to overcome difficult IV

		yes	no	total
Nurse	Count	22	79	101
	% within Occupation	21.8%	78.2%	100.0%
Anesthesia Technician	Count	8	6	14
	% within Occupation	57.1%	42.9%	100.0%
Phlebotomist	Count	2	6	8
	% within Occupation	25.0%	75.0%	100.0%
Total	Count	32	91	123
	% within Occupation	26.0%	74.0%	100.0%

Table 10: Good device

		Accu vein	Vienlite	not applicable	Total
Nurse	Count	5	17	79	101
	% within Occupation	5.0%	16.8%	78.2%	100.0%
Anesthesia Technician	Count	3	5	6	14
	% within Occupation	21.4%	35.7%	42.9%	100.0%
Phlebotomist	Count	0	2	6	8
	% within Occupation	0.0%	25.0%	75.0%	100.0%
Total	Count	8	24	91	123
	% within Occupation	6.5%	19.5%	74.0%	100.0%

Table 11: Obstacles regarding introducing new device

		Lack of training	Too complicated device or poorly designed	Device doesn't perform intended function	Too expensive	Impractical	total
Nurse	Count	61	19	4	10	13	87
	% within Occupation	70.1%	21.8%	4.6%	11.5%	14.9%	
	% of Total	56.0%	17.4%	3.7%	9.2%	11.9%	79.8%
Anesthesia Technician	Count	8	4	3	2	2	14
	% within Occupation	57.1%	28.6%	21.4%	14.3%	14.3%	
	% of Total	7.3%	3.7%	2.8%	1.8%	1.8%	12.8%
Phlebotomist	Count	3	3	0	0	3	8
	% within Occupation	37.5%	37.5%	0.0%	0.0%	37.5%	
	% of Total	2.8%	2.8%	0.0%	0.0%	2.8%	7.3%
Total	Count	72	26	7	12	18	109
	% of Total	66.1%	23.9%	6.4%	11.0%	16.5%	100.0%