

Local complications of intravenous access – an often underestimated entity

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ABSTRACT

Context: Obtaining intravenous (IV) access is one of the very frequent invasive procedures performed in hospital care settings. This has several complications some of which are serious in nature. However, the incidence and seriousness of these complications as well as the burden of this complication on patient management are often underestimated. Identification of susceptible patients and the risk factors are important to ensure better outcomes. **Aims:** The aim of this study was to document the various local complications of intravenous access and to identify the risk factors associated with it. **Settings and Design:** Prospective observational study with three hundred and one surgical patients. Study duration of 1 year. **Methods and Material:** Indication of IV access, site, size of IV cannula used, category of personnel involved as well as local complications at access site were documented. Dressing at cannula site were changed every 72 h or earlier. Cannula and site of access were changed in case of any complication. **Statistical Analysis Used:** Results analysed using SPSS software (IBM Inc). Frequency calculated as average and percentage. Chi-square test used for statistical significance. Relative risk calculated. **Results:** Females, overweight, diabetics and smokers were found at more risk. Requirement of major surgery, IV access by paramedical personnel, IV access over joints and when kept beyond 3 days were found to have more complications. 5.7% of patients had serious complications requiring surgical intervention. **Conclusions:** Our study shows that local complications at IV access site are very common with occurrence in more than fifty percent patients. Several risk factors are identified. Not all demographic and clinical risk factors are readily modifiable. However many of the complications can easily be minimized by following basic precautions.

Keywords: Intravenous access, local complications, serious

Introduction

Intravenous (IV) access is one of the most frequently performed invasive procedure by in health care scenario.^[1,2] It is essential for parenteral infusion of therapeutic substances and is often inevitable in hospital care settings. Being an invasive procedure it is not without its fair share of complications. However, being considered a “minor” category of procedure, its complications are often overlooked. Considering that the

vast majority of the patients being treated as inpatients in health care facilities have to undergo this invasive procedure however innocuous, the total burden of the complications of this procedure on patient management cannot be ignored. This effect of such complications is more felt in a country like India, where there is wide asymmetry in access to health care between rural and urban populace.^[3] Identification of patients who are susceptible, in addition to following proper practice of IV access will not only reduce the rate of such complications but also decrease hospital stay and ensure better outcomes. In the current prospective study we have documented the various local complications of IV access and tried to identify the various risk factors in such cases.

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Subjects and Methods

This prospective observational study was performed with 301 patients at R D Gardi medical college and hospital, Ujjain for a period of 1 year (April 2015–March 2016). After obtaining institutional ethics clearance patients admitted in the department of surgery and receiving intravenous therapy were recruited in the study. Immunocompromised patients like HIV/AIDS, on chronic steroid therapy or pre-existing chronic infections like tuberculosis were excluded from the study. Indication of IV access, site, size of IV cannula used, category of personnel involved as well as local complications at access site were documented. Insertion of IV cannula was done according to standard technique. Selection of site for IV access & size of IV cannula was decided on the basis of accessibility and condition of veins, diagnosis, clinical status of patients, surgery planned, expected postoperative management and length of infusion therapy. Type and flow rate of infusion was adjusted according to patients condition and therapeutic requirement. Dressing at cannula site were changed every 72 h or earlier. Cannula and site of access were changed in case of any complication. Data analysis was done using SPSS (IBM Corp.)

Results

The mean age of patients was 33.92 yrs (range 3 yr - 88 yrs) Among the study subjects 71.8% were male ($n = 216$). 67.4% of the patients ($n = 203$) had a normal BMI, 14.28% of patients were diabetic ($n = 43$) and history of smoking was documented in 20.6% patients ($n = 62$) [Table 1]. Requirement of major surgery was the indication of IV access in most patients (81.1% $n = 244$) and most of the IV access was obtained by nursing personnel (71.1%, $n = 214$) [Table 2]. Forearm was the commonest site of access (46.2%, $n = 139$) and the most commonly used catheter gauge was 18G (52.2% $n = 157$) [Table 3]. A total number of 157 patients were documented where complications occurred (52.15% $n = 157$) The commonest complication was phlebitis (21.6%, $n = 65$) followed closely by infiltration (14%, $n = 42$) [Table 4]. Four patients developed localized allergic reaction to adhesive plaster used to secure the IV cannula. Complications were seen more in female patients ($m = 48.7\%$ $f = 61.2\%$ $P = 0.0494$) and patients who were overweight and obese ($p = 0.00015$), diabetics ($p = 0.0003$) and smokers ($p = 0.002$) [Table 5]. IV access for major surgery was a risk factor when compared to minor surgery or nonoperative management [$p = 0.0015$], and 85.71% of patients having access in the cubital fossa had complications which was higher than other sites and it was statistically significant ($p = 0.00001$). 79.31% of patients where access was obtained by paramedical personnel had complications, compared to when obtained by doctors (51.2%) or nursing personnel (48.59%) which was statistically significant ($p = 0.007$) [Table 6]. Duration of cannulation also had a bearing on the incidence of complications. 75.45% of patients where IV access was kept for 4 or more days had complications where as only 38.74% of those had complications when IV access was removed

Table 1: Demography and Risk Factors

	Number of cases (n)	Percentage
Gender		
Male	216	71.8
Female	85	28.2
BMI		
Underweight	80	26.6
Normal	203	67.4
Overweight	13	4.3
Obese	5	1.7
Smoking		
Yes	62	20.6
No	239	79.4
Diabetes		
Yes	43	14.28
No	258	85.72

Table 2: Indications for intravenous access

	No. of cases	%
Indication		
Major Surgery	244	81.1
Minor Surgery	54	17.9
Non operative management	3	1
Inserted by		
Staff Nurse	214	71.1
Doctor	58	19.3
Paramedic	29	9.6

Table 3: Site of IV access and size of cannula used

	No. of cases	%
Site		
Hand	82	27.2
Fore Arm	139	46.2
Cubital Fossa	42	14.0
Foot	12	4.0
Wrist	15	5.0
Internal Jugular	11	3.7
Size of cannula used (G)		
18	157	52.2
20	88	29.2
22	27	9.0
24	16	5.3
7 fr central line	13	4.3

within 3 days (Relative risk 1.94 $P < 0.0001$) [Table 7]. Out of the total number of patients who developed complications, 9 patients (5.7%) developed serious complications requiring surgical intervention either during the same hospitalisation or on follow-up [Table 8].

Discussion

IV access is probably the most frequently performed invasive procedure undergone by patients admitted in hospital wards.^[1,2] However, it often doesn't get enough clinical attention because of ubiquitous-ness of the procedure, even though complications are

fairly common and can be serious.^[4,5] In our study complications were more in female and in overweight patients which is similar to findings reported by Dychter SS *et al.*^[6] Forni C *et al.*^[7] and Smita Prakash *et al.*^[8] The presence of relatively more subcutaneous fat in females and in overweight patients might make the process of obtaining an IV access more difficult.^[5] Studies have recommended real-time ultrasound guided placement in patients with difficult peripheral venous access thereby reducing procedure time, number of attempts, vascular, infectious as well as neurological complications.^[9] Increased complication in

diabetic patients can be due to age related fragility of veins.^[10] as well as anatomically distorted veins due to more frequent hospitalization in diabetic patients.^[11] Chance of complication like dislodgement and infiltration are more if the access site is exposed to repeated movement i.e over a joint. We had more complications when the site was cubital fossa followed by wrist area which is similar to findings in previous studies.^[12] Efforts should be made to avoid placing access directly over joints to prevent this. In a country like India, building and empowering primary health care teams have been proposed to address the gross disparity in healthcare access of rural populace compared to urban population. This includes proper training of the primary healthcare team for providing comprehensive healthcare.^[13] IV access is the essential step in providing fluid therapy and in primary health care setting with limited resources and expertise, a proper and durable intravenous access helping in prompt institution of treatment often before referral to higher centres may be an important clinical factor influencing patient prognosis. In our study complication was more when it was done by a paramedical staff compared to doctor and nurses. This places the emphasis on proper training of paramedical personnel are often the first responders to a clinical situation in such settings. We also found that complication risk significantly increases if the access is maintained for 4 days or more (Relative risk 1.94 $P < 0.0001$). That also explains the increased complication rates in patients undergoing major surgery. This is in agreement with category IA recommendations that IV catheters should be removed as soon as the requirement of Iv administration is over.^[14,15] Our findings therefore indicate that changing the catheter site regularly after 3 days might decrease complication rate These findings are in contraindication with the study by Claire M Rickard *et al.* which found that catheter change is more beneficial when clinically indicated rather than based on duration.^[16] On the other hand, this study is in agreement with more recent Cochrane database systematic review by Joan Webster *et al.* that routine replacement of catheter reduces not only the rate of infiltration, but also the rates of catheter blockage^[17]. It should be rational to recommend that IV catheters should be removed promptly when not indicated anymore and there is no benefit in keeping

Table 4: Complications

Complications	No of cases	%
Phlebitis	65	21.6
Infiltration	42	14.0
Hematoma	17	5.6
Thrombophlebitis	5	1.7
Abscess	3	1.0
Cellulitis	3	1.0
Bleeding	7	2.3
Arterial Bleed	2	0.7
Extravasation	5	1.7
Allergy	4	1.3
Skin necrosis	4	1.3
Total	157	52.15%

Table 5: Demographic and behavioral risk factors

	No. of cases	No. of complications	Percentage	P
BMI				
Underweight	80	50	26.6	$P=0.00001$
Normal	203	91	67.4	
Overweight and obese	18	16	5.98	
Smoking				
Yes	62	43	69.3	$P=0.002$
No	239	114	47.6	
Diabetes				
Yes	43	35	81.39	$P<0.00003$
No	258	122	47.28	

Table 6: Relationship of complications to Site of access, involved personnel and type of surgery

	No. of cases	No. of Complication	Percentage	P
Type of Surgery				
Major	244	138	56.5	$P=0.0015$
Minor and Non operative management	57	19	33.3	
Site				
Hand	82	39	47.56	$P=0.00001$
Fore Arm	139	55	39.56	
Cubital Fossa	42	36	85.71	
Foot	12	8	66.66	
Wrist	15	11	73.33	
Internal Jugular	11	8	72.72	
Inserted by				
Staff Nurse	214	104	48.59	$P=0.007$
Doctor	58	30	51.72	
Paramedical Personnel	29	23	79.31	

them as 'prophylaxis' of future requirement. In this study, out of 301 patients 52.15% developed complications (157). 91.7% of the complications were managed medically (antibiotics, limb elevation, anti-inflammatory drugs [oral/topical] and those patients who developed serious local complications such as suppurative thrombophlebitis, large ulcers, abscess and local tissue necrosis, required surgical intervention like incision and drainage, debridement and even split skin grafting for coverage of residual wound. Considering that the most of the serious complications were infective in nature and preventable, the essentiality of maintaining strict asepsis cannot be over emphasized. The key learnings based on our study findings have been summarized [Table 9].

Conclusion

In conclusion, our study shows that local complications at IV access site are very common with occurrence in more than fifty percent of our patients and is often underestimated. Female patients, patients who are overweight, diabetic, smokers as well as where IV catheters were kept for longer periods, all were found to be more at risk for developing local complications at the IV access site. To reduce the occurrence of complications, IV catheters should be removed as soon as the requirement is over or might be changed to a different site if they have to be kept for more than 3 days. However not all risk factors are readily modifiable for example BMI, female sex, diabetic status and requirement of major surgery. At the very least in this era of doctors being increasingly held legally responsible for various

Table 7: Complications vs duration of IV access

Duration of IV access	No. of patients	Complications	P
0-3	191 (63.45%)	74 (47.13%)	$P < 0.0001$
4 or >	110 (36.54%)	83 (52.86%)	RR=1.94
Total	301	157	

Table 8: Complications requiring surgical intervention

Complications	No. of patients
Ulcer	2
Abscess	1
Suppurative Thrombophlebitis	2
Necrosis Over Infusion Site	4

Table 9: Key learnings from our study

Always maintain strict aseptic technique while obtaining IV access
 Careful monitoring of IV access in females, diabetics, smokers, obese and in patients undergoing major surgery
 In difficult cases consider utilising real-time ultrasound guidance (if available)
 Avoid placing catheter over joints like cubital fossa and wrist
 Change IV catheter every 3 days even if there is no visible complication
 Consider obtaining IV access by trained personnel like doctors and nurses as it has less complications
 Emphasise on proper training of paramedical health care workers in this basic procedure

medical complications, many of the complications can easily be minimized by following basic precautions and avoiding common pitfalls like placing the IV catheter over joints and maintaining strict aseptic technique. Our findings also emphasize proper training of primary healthcare personnel who are the first responders mainly in primary health care settings. One of the important complications of IV access which cannot be overlooked is catheter associated systemic blood stream infection but that was outside the purview the current study. We have planned a follow up study to address this issue.

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Conflicts of interest

There are no conflicts of interest.

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