

# Peripheral intravenous catheter-related phlebitis and related risk factors

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## ABSTRACT

**Introduction:** Peripheral intravenous catheter-related phlebitis is a common and significant problem in clinical practice. This study aims to investigate the incidence of phlebitis and to evaluate some important related factors.

**Methods:** 300 patients admitted to medical and surgical wards of hospitals in Semnan, Iran from April 2003 to February 2004 were prospectively studied. Variables evaluated were age, gender, site and size of catheter, type of insertion and underlying conditions (diabetes mellitus, trauma, infectious disease and burns). Phlebitis was defined when at least four criteria were fulfilled (erythema, pain, tenderness, warmth, induration, palpable cord and swelling). Any patient who was discharged or their catheter removed before three days were excluded.

**Results:** Phlebitis occurred in 26 percent (95 percent confidence interval [CI] 21-31 percent) of patients. There was no significant relationship between age, catheter bore size, trauma and phlebitis. Related risk factors were gender (odds-ratio [OR] 1.50, 95 percent CI 1.01-2.22), site (OR 3.25, 95 percent CI 2.26-4.67) and type of insertion (OR 2.04, 95 percent CI 1.36-3.05) of catheter, diabetes mellitus (OR 7.78, 95 percent CI 4.59-13.21), infectious disease (OR 6.21, 95 percent CI 4.27-9.03) and burns (OR 3.96, 95 percent CI 3.26-4.82).

**Conclusion:** Phlebitis is still an important and ongoing problem in medical practice. In patients with diabetes mellitus and infectious diseases, more attention is needed.

**Keywords:** burns, catheter-related complications, diabetes mellitus, peripheral intravenous catheter, phlebitis

## INTRODUCTION

The progress of medical science and technology has been accompanied by the use of new diagnostic and therapeutic devices, each of which is associated with its own complications. One of the devices most used is the peripheral intravenous catheter (PIC) for drugs, fluid and blood product administration, or blood sampling.<sup>(1)</sup> One of the most common complications of PIC is phlebitis that may occur in up to 75% of hospitalised patients.<sup>(2)</sup> It remains a significant problem in clinical practice and causes patient discomfort, catheter replacement, prolonged hospital stay and healthcare costs. Maintenance of the patency of these catheters and prevention of phlebitis is an important problem.<sup>(3)</sup>

Phlebitis refers to the clinical finding of pain, tenderness, swelling, induration, erythema, warmth and palpable cord-like veins due to inflammation, infection, and/or thrombosis.<sup>(4)</sup> Many factors have been implicated in the pathogenesis of phlebitis, namely: (1) chemical factors such as irritant drugs and fluids; (2) mechanical factors such as catheter material, size, site and duration of cannulation; and (3) infectious agents. Patient factors that may affect the rate of phlebitis include age, gender and underlying conditions (i.e. diabetes mellitus, infections, burns).<sup>(5)</sup> Because a review of the literature shows great disparities between results of studies, especially the relative importance of risk factors, we designed a prospective study to evaluate the incidence of phlebitis and relative roles of some potential factors in the aetiology of phlebitis.

## METHODS

In this prospective study, we included 300 patients that were admitted to two educational university-affiliated hospitals (internal and surgical), and in whom PICs were inserted. Choice of intravenous site and size of catheter were at the discretion of skilled nurses. All catheters were made from similar material and changed every 72 hours. Variables recorded were: age, gender, site and type of insertion, catheter gauge and underlying diseases (diabetes mellitus, burns, trauma and infectious disease). Infectious diseases were defined as bacterial infections (based on CDC criteria) in patients without other comorbidities and that which required antibiotic therapy.

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**Table I. Incidence of phlebitis in the study patients (non-related factors).**

| Parameter        | Sample size | Phlebitis (n) | Incidence of phlebitis (%) | Odds-ratio (OR) | 95% CI for OR |
|------------------|-------------|---------------|----------------------------|-----------------|---------------|
| Age              |             |               |                            |                 |               |
| < 60 years       | 169         | 47            | 27.8                       | 1.18            | 0.79–1.74     |
| ≥ 60 years       | 131         | 31            | 23.7                       |                 |               |
| Trauma           |             |               |                            |                 |               |
| Yes              | 58          | 19            | 32.8                       | 1.34            | 0.87–2.07     |
| No               | 242         | 59            | 24.4                       |                 |               |
| Size of catheter |             |               |                            |                 |               |
| 20G              | 109         | 30            | 27.5                       | 1.11            | 0.75–1.65     |
| 18G              | 190         | 47            | 24.7                       |                 |               |

**Table II. Incidence of phlebitis in the study patients (related factors).**

| Parameter                  | Sample size | Phlebitis (n) | Incidence of phlebitis (%) | Odds-ratio (OR) | 95% CI for OR |
|----------------------------|-------------|---------------|----------------------------|-----------------|---------------|
| Gender                     |             |               |                            |                 |               |
| Female                     | 155         | 48            | 31.0                       | 1.50            | 1.01–2.22     |
| Male                       | 145         | 30            | 20.7                       |                 |               |
| Diabetes mellitus          |             |               |                            |                 |               |
| Yes                        | 111         | 64            | 57.7                       | 7.78            | 4.59–13.21    |
| No                         | 189         | 14            | 7.4                        |                 |               |
| Burns                      |             |               |                            |                 |               |
| Yes                        | 3           | 3             | 100                        | 3.96            | 3.26–4.82     |
| No                         | 297         | 75            | 25.3                       |                 |               |
| Infectious disease         |             |               |                            |                 |               |
| Yes                        | 67          | 50            | 74.6                       | 6.21            | 4.27–9.03     |
| No                         | 233         | 28            | 12.0                       |                 |               |
| Site of catheter           |             |               |                            |                 |               |
| Lower extremities          | 13          | 10            | 76.9                       | 3.25            | 2.26–4.67     |
| Upper extremities          | 287         | 68            | 23.7                       |                 |               |
| Type of catheter insertion |             |               |                            |                 |               |
| Urgent                     | 140         | 50            | 35.7                       | 2.04            | 1.36–3.05     |
| Non-urgent                 | 160         | 28            | 17.5                       |                 |               |

Patients were visited daily by one infectious disease specialist for the assessment of the clinical criteria of phlebitis (erythema, warmth, swelling, induration, tenderness and palpable cord). To increase the accuracy of detection of phlebitis, unlike other studies, we used four criteria for definition of phlebitis. Patients who were discharged or had their PIC removed within three days were excluded. The study was done to determine the incidence of phlebitis and to identify risk factors that predict an increased susceptibility to phlebitis. Logistic regression analysis was performed to estimate the effects of the suspected risk factors for developing phlebitis. We used backward stepwise regression to determine which factors were

most strongly associated with the outcome. The relative risk of possible risk factors was estimated by the calculation of odds-ratio (OR) and 95% confidence interval (CI).

## RESULTS

Of 300 patients, 145 (48.3%) were male and 155 (51.7%) were female. Mean ( $\pm$  standard deviation) age of patients was 51.8 ( $\pm$  22.5) years. 56.3% were younger than 60 years old. Catheters were inserted for reasons such as administration of fluids, intravenous drugs and blood products. Catheter gauge size was 20 in 190 patients, 18 in 109 patients, and 22 in one patient. 287 catheters were inserted in the upper extremities and 13

in the lower extremities. Catheter insertion was urgent in 140 patients and elective in 160 patients. Phlebitis occurred in 26% (95% CI 21–31). There was no significant relationship between age, size of catheter, trauma and phlebitis (Table I). The incidence of phlebitis in females and males was 31% and 20.7%, respectively. 57.7% of diabetic patients and 7.4% of non-diabetics developed phlebitis. Independent risk factors associated with phlebitis were gender, site and type of catheter insertion, diabetes mellitus, infectious diseases and burns (Table II).

## DISCUSSION

Phlebitis is the most common complication of intravenous catheters and can lead to many problems and costs. It is now well established that the aetiology of phlebitis is multifactorial. In our study, the incidence of phlebitis was 26%. Because we used four criteria for the diagnosis of phlebitis, we can conclude that the problem is significant. Most other studies used at least two criteria for diagnosis. In the study by Maki and Ringer which used two or more criteria, the incidence was 41.8%.<sup>(6)</sup> The incidence of phlebitis was found to be 39% by Monreal et al,<sup>(7)</sup> and 36.5% by Karadag and Gorgulu.<sup>(8)</sup> In some other studies, the incidence was lower than what we had found.<sup>(3,9-11)</sup> The female gender was an associated risk factor in our study (OR 1.50, 95% CI 1.01–2.22), which is in agreement with some other studies;<sup>(6,12)</sup> but Tager et al<sup>(11)</sup> and Cornely et al<sup>(13)</sup> found that gender was not a risk factor. We have no satisfactory explanation for this observation, but the hypothesis is that hormonal differences may be a contributing factor for phlebitis in females.

In contrast to other studies,<sup>(9,14)</sup> the incidence of phlebitis in our patients  $\geq 60$  years old was lower than those  $< 60$  years old (OR 1.18, 95% CI 0.79–1.74). Because the inflammatory response in the elderly is often impaired, signs and symptoms of phlebitis may be subtle. In addition, we used four criteria, and elderly patients may have presented with fewer signs and symptoms. Consistent with other studies,<sup>(6,15,16)</sup> we found that phlebitis is more common when the catheter is inserted in the lower extremities (OR 3.25, 95% CI 2.26–4.67), and in an emergency situation (OR 2.04, 95% CI 1.36–3.05). In emergency insertions, preparatory care may have been inadequate and mechanical irritation of the vein wall is more common.

One of the most striking findings of our study was the relationship between diabetes mellitus and phlebitis. In diabetic patients, phlebitis was 7.8 times more common than in nondiabetics (OR 7.78, 95% CI 4.59–13.21). This risk factor was evaluated in a few studies. In Monreal et al's study, diabetes mellitus was not

a risk factor.<sup>(7)</sup> A higher rate of phlebitis in these patients may be due to the endothelial damage induced by diabetes mellitus, that predisposes patients to phlebitis. Good control of diabetes mellitus, greater attention and care during insertion, and changing catheters within 72 hours may reduce the rate of phlebitis in these patients.

Our study confirms the findings of some other studies<sup>(6,9,17)</sup> in that infectious diseases increase risks of phlebitis (OR 6.21, 95% CI 4.27–9.03). One of the reasons may be related to the fact that the intravenous antibiotics used in these patients cause chemical irritation of the endothelium, with resultant phlebitis. Large bore catheters generally cause more phlebitis due to greater mechanical irritation. However, in contrast to most studies,<sup>(6,14,18,19)</sup> our findings did not show catheter bore as a risk factor for phlebitis (OR 1.11, 95% CI 0.75–1.65). One of the possible reasons may be that very large bore catheters (16G) were not used in our patients.

Future studies are needed to improve the understanding of risk factors for phlebitis, especially diabetes mellitus and infectious diseases, and to discover more effective protection methods. Based on our findings, we believe that if certain variables influencing the risk of phlebitis (especially diabetes mellitus, infectious diseases and gender) are taken into consideration, the rate of phlebitis can be reduced in high risk groups by: shortening the intervals between catheter replacements, better supervision during insertion and maintenance of catheters, use of milder irritant intravenous drugs, especially with respect to antibiotics, and better control of underlying diseases.<sup>(1,6,11)</sup>

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