Risk factors associated with difficult peripheral venous cannulation: a meta-analysis of published studies

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Introduction:

Peripheral intravenous catheterization (PIVC) is a common technique in hospitals. Cannulation failure results in multiple punctures and degradation of the vessels. This situation termed difficult peripheral intravenous cannulation (DPIVC) is associated to delays in treatment and diagnosis, and a higher use of central lines.

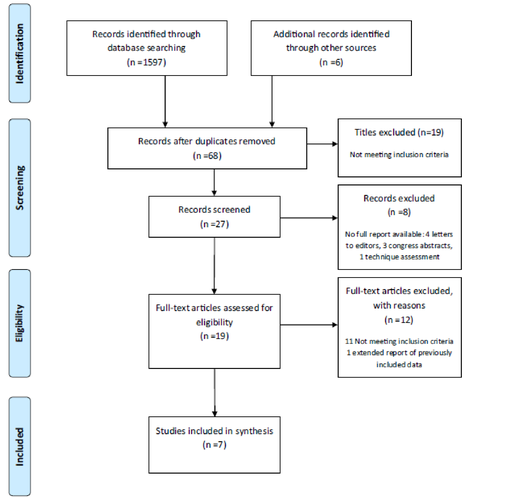
In order to prevent DPIVC, this study intends to identify risk factors associated to DPIVC in adults at hospital.

Methods:

Systematic review of published studies (protocol PROSPERO 2018 CRD42018089160). Structured electronic searches were conducted using key words and specific vocabulary. Validity analysis was carried out with Newcastle-Ottawa validated tool. We calculated Odds ratios (OR) for statistically significant variables in every single study.

Variables homogenously distributed were analyzed with meta-analyses, which were adjusted for study design and type of outcome.

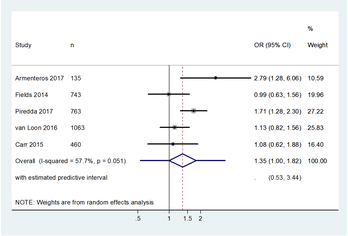
Flowchart of study selection



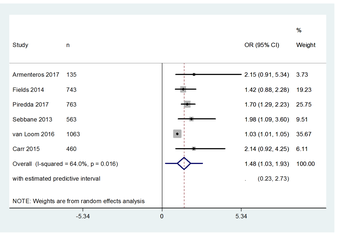
Characteristics of selected studies

AUTHOR, YEAR	COUNTRY	SAMPLE SIZE	CONTEXT / POPULATION	DESIGN	1ST ATTEMPT SUCCESS	DIVA RATE
Sebbane 2013	France	563	Emergency	Observacional Prospective	79%	21%
Fields 2014	USA	743	Emergency	Observacional Prospective	75,6%	11,8%
Carr 2016	Australia	734	Emergency	Cohort	82,87%	17,12%
van Loon 2016	The Netherlands	1063	Operation room	Cross-sectional	85,69%	Not measured
Armenteros-Yeguas 2017	Spain	135	Advanced chronic	Cross-sectional	Not measured	59,3%
Piredda 2017	Italy	763	Radiology	Observacional Prospective	88,9%	39,4%
Witting 2017	USA	358	Emergency	Case-Control	Not reported	Not reported

Femenine gender



BMI > 30



Discussion & Conclusions:

Our study identifies the most relevant variables to conform future research and points out obesity as a relevant element to be considered in clinical practice to prevent DPIVC.

It is key to design further research with diverse populations and a wide selection of potential risk factors. Consensus must also be reached regarding the definition of DPIVC to allow the comparability among studies.

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Results:

We selected 7 studies with observational methodology, with a relevant variability in the definition of DPIVC and in the variables included. Significant variables include demographic and anthropometric variables (ie. gender, BMI), health conditions (ie. diabetes, renal insufficiency, parenteral drug abuse, cancer, chemotherapy), and variables related to the vascular access (vein visibility/palpability, diameter of the vessel, previous history of difficulty). In some studies, variables related to the professional were also considered.

Two variables met criteria for meta-analyses: gender and obesity/BMI. We found statistical significance for obesity with OR of 1.48; 95%CI (1.03 to 1.93; p=0.016).

The risk factors

RISK FACTOR	Armenteros-Yeguas 2017	Carr 2016	Fields 2014	Piredda 2017	Sebbane 2013	van Loon 2016	Witting 2017
DEMOGRAPHIC FACTORS							
Age	IR	3,04 (1,05-8,83) >80 years	0.97 (0.55-1.91) >64 years	1.17 (0.92-1.48) >64 years	IR	IR	
Femenine gender	2,85 (1,31-6,25) Female	1.88 (1.09-3.25)	0.99 (0.62-1.56)	1,68 (1,28-2,21) Female	IR	0.89 (0.64-1.22)	
CONDICIONES DEL ACCESO VASCULAR							
Catheter size		6,4 (3,4-11,9) 22-24G vs >20G		0.74 (0.51-1.08) 20G	IR	5.56 (2.63-11.73) 22G	
Vein diameter<2mm		2.97 (1.67-5.31)				3,37 (2,12-5,36)	
Previous history of difficulty	2.14 (1.06-4.33)		16,7 (6,8-41)	5,05 (3,34-7,62)		3,86 (2,39-6,25)	6,1 (3,3-11,3)
Vein palpability		5,05 (1,37-18,64) Not palpable		0,78 (0,73-0,83) Palpable	IR	4,94 (2,85-8,56) No palpable	
Vein visibility		4,62 (2,17-9,86) Not visible		0,87 (0,83-0,91) Visible	IR	3,63 (2,09-6,32) Notvisible	
HEALTH CONDITIONS							
IMC >30 / ObesiTY	2.15 (0.96-4.82)	2.29 (0.99-5.31)	1,42 (0.90-2.23)	1,70 (1,37-2,10)	1,98 (1,09-3,60)	1,03 (1,01-1,05)	0.63 (0.37-1.05)
Cancer	2.14 (0.89-5.15)			1,97 (1,3-2,97)			
Quimiotherapy			1.29 (0.65-2.56)	1,69 (1,17-2,44)		1.21 (0.66-2.21)	
Diabetes	1.26 (0.63-2.51)		2,1 (1,3-3,4)	2,41 (1,05-5,49)		0.95 (0.59-1.54)	1.6 (1.0-2.8)
Hypotension						8,15 (3,75-17,71)	0.75 (0.32-1.73)
Parentheral drugs abuse	0.82 (0.31-2.12)		2,4 (1,1-5,3)	IR		1.30 (0.59-2.89)	4.7 (2.9-9.1)
Chronic renal failure / Haemodialysis	1.00 (0.42-2.36)		0.73 (0.16-3.21)			1,83 (1,02-3,26)	1.66 (0.82-3.8)
Vascular disease	3.90 (0.73-20.88)					1,88 (1,35-2,62)	
CONTEXT							
Unplanned surgery						4,86 (2,92-8,07)	
PROFESSIONAL							
>100 insertions		5,5 (1,86-16,30)					
>800 insertions		7,64 (2,48-23,51)					
Perceived difficulty		1,06 (1,04-1,07)		IR			

Green: Statistical significance in multivaraite analysis
Yellow: Statistical significance in univariate analysis
IR: Insufficent reporting