Patterns and predictors of difficult intravenous access among children presenting for anesthesia

Patak L, Collins M, Groenewald C

Seattle Children's HOSPITAL · RESEARCH · FOUNDATION

UW Medicine
UW SCHOOL OF MEDICINE

INTRODUCTION

- Difficult peripheral intravenous (PIV) access is common amongst hospitalized patients and may lead to increased cost.
- Emergency Departments (ED) consistently report an incidence of 5%
- Difficult IV Access (DIVA) scoring is well validated; however, this scoring system only predicts the likelihood of success with the first attempt and presents several limitations:
  1. It's predictable success rate applies to ED nurses.
  2. The relationship between difficulty and number of attempts is not linear.
     i. Patients with easy IV access may require greater than 1 attempt.
     ii. Patients with difficult access may only require 1 attempt.
  3. Difficulty is a subjective assessment of one's performance and is qualified by the individual performing the task and takes into account one's skill, past experience and interpretation of the immediate experience.
- No studies exist that describe DIVA in the perioperative setting nor its impact on operating room (OR) time.

HYPOTHESIS/AIMS

- The aim of this study was to describe patterns and predictors of difficult PIV placement among children presenting to a large, tertiary care children's hospital in the United States and determine its impact on operating room (OR) time.
- We hypothesized the incidence of difficult PIV placement to be 5% and anticipated an association with younger age, increased ASA status, and increased BMI. We further hypothesized difficult IV's would require 3x's the time to achieve successful placement.

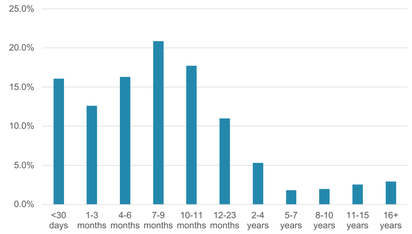
METHODS

- A retrospective analysis was performed on all anesthesia records from years 2015 to 2016 from an academic, tertiary care, pediatric hospital.
- We included all cases where a PIV was placed in the OR and excluded all emergency cases and where a PIV was present prior to entering the OR.
- Difficulty with PIV placement was assessed and documented by individual anesthesiology providers.
- Time was measured in minutes from the time of entering the operating room to the time of PIV placement.
- Multivariate logistic regression analysis was used to determine whether age, sex, ASA status, and BMI were associated with difficult PIV placement.

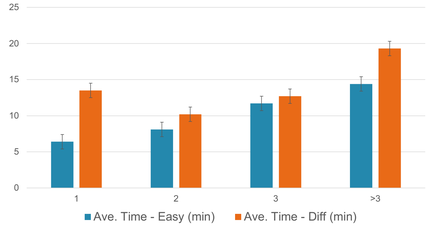
RESULTS

- We identified 14,995 children 0-18 years of age, who underwent 19,212 anesthetics during the period of study.
- Difficult PIV placement was documented in 1,049 (5.5%) of anesthetics and 7.0% of patients.
- Seventy-two percent (13,964) of PIV's were placed on the first attempt while only 3.7% (716) required >3 attempts.

Percent DIVA by Age Group



Comparing Time to IV Placement with Number of Attempts

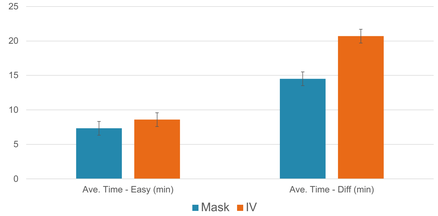


DIVA Score ≥ 4 Predicts > 50% failed 1st Attempt

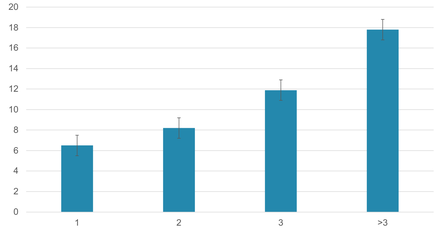
Predictor Variable	Scores		
Visibility Palpability	Visible = 0 Palpable = 0		Not visible = 2 Not palpable = 2
Age	≥36 months = 0	12–35 months = 1	< 12 months = 3
Prematurity	Not premature = 0		Premature = 3
Skin shade	Light = 0	Dark = 1	

- Mean age of the sample was 8.1 years (standard deviation = 5.9 years).
- 55.8% were male with no significant difference with difficulty associated with gender.
- Time to IV placement is longer with IV induction vs mask induction, irrespective of difficulty; 8.0 vs 6.9 min (easy; P = 0.000); 20.7 vs 14.5 (difficult; P = 0.016).

Comparing Average Time Between Difficult and Easy IV Access, Mask vs IV Induction



Average Time for Each Attempt All IV's



- Time to IV placement increased 45% between 2nd and 3rd attempts and increased 50% between 3rd and >3 attempts.

Predictors of Difficult IV Placement

	Odds Ratio	95% Confidence Interval	P value
ASA 1	(ref)		
ASA 2	**1.38**	**1.12-1.70**	**0.002**
ASA 3	**3.40**	**2.79-4.15**	**0.000**
ASA 4	**3.19**	**2.32-4.38**	**0.000**
1-3 Months	1.08	0.63-1.85	0.788
4-6 Months	1.60	0.96-2.66	0.071
7-9 Months	**2.46**	**1.47-4.10**	**0.001**
10-11 Months	**2.07**	**1.20-3.56**	**0.008**
12-23 months	1.17	0.71-1.91	0.539
2-4 Years	**0.49**	**0.30-0.79**	**0.004**
5-7 Years	**0.16**	**0.09-0.28**	**0.000**
8-10 Years	**0.16**	**0.09-0.28**	**0.000**
11-15 Years	**0.23**	**0.14-0.39**	**0.000**
16+ Years	**0.24**	**0.14-0.41**	**0.000**
Male	0.98	0.84-1.12	0.740
BMI	**1.13**	**1.12-1.15**	**0.000**

DISCUSSION

Our data reports 3 outcome measures for perioperative difficult IV's: 1) subjective rating by anesthesiologists, 2) number of attempts, and 3) time. Time for IV placement doubles between 2 and > 3 attempts, which may justify implementing an evidence-based difficult IV placement algorithm aiming for no more than 3 attempts. Establishing competence using ultrasound guidance may help reduce the number of attempts when placing difficult IV's. Limitations in our study include lack of DIVA scoring, no data on who placed IV (attending/trainee), and use of retrospective EMR data. Narrow CIs suggest large sample size may have overcome unidentified confounding variables. DIVA score will be used with future data collection. Next steps include implementation of an evidence-based difficult IV algorithm and ultrasound guided IV placement training establishing competence throughout the department followed by data analysis to determine the impact of these two interventions.

CONCLUSION

This retrospective study of 19,212 perioperative IV placement procedures in an academic, tertiary care, pediatric hospital establishes decreasing age, increasing ASA status and increasing BMI as predictors for difficult PIV access. The incidence of difficult PIV access in the perioperative setting is 5.5%.

REFERENCES

Goff DA, et al. *Hosp Pediatr*. 2013;3(3):185-91.
Petroski A, et al. *J Vasc Access*. 2015;16(6):521-26.
Duran-Gehring P, et al. *J Ultrasound Med*. 2016;35:2343-52.
Riker MW, et al. *Acad Emerg Med*. 2011;18:1129-34.