

Research Progress of Assessment Tools for Peripheral Venous Access Difficulties in Children

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Abstract: *Objective:* To review the research progress of peripheral venous access difficulty assessment tools in children and to provide a reference for clinical nurses to select and develop appropriate assessment tools. *Methods:* Search the literature at home and abroad and summarize and analyze the existing evaluation tools. *Results:* There is no unified assessment tool about difficult venous access in children at home and abroad. The existing tools include the difficult venous access assessment scale and peripheral venous grading assessment tool. *Conclusion:* The current assessment tools for venous access difficulties in children have their own limitations, and it is necessary to develop further the assessment tools suitable for the cultural background of children's venous access difficulties. This paper summarized the current progress of research on peripheral venous access difficulty assessment tools. It also analyzed and summarized the shortcomings of existing tools to provide a reference for clinical staff to choose appropriate assessment tools.

Keywords: Children; Difficult intravenous access; Evaluation tools; Review

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1. Introduction

Peripheral intravenous infusion therapy is a common invasive procedure in the treatment of pediatric diseases. The Infusion Therapy Standards of Practice (INS) states that when patients with vein difficulties are encountered, it is recommended to use the difficult venous access assessment tool for venous assessment and to refer them to an intravenous specialist or for guidance as soon as possible^[1]. This study analyzed the domestic and foreign research status of assessment tools for children's difficult peripheral venous access, aiming to provide a reference for the later development of research tools suitable for China's national conditions.

1.1. Definition and status of difficult intravenous access

At present, the definition of Difficult Intravenous Access (DIVA) is not uniform. It is generally believed that DIVA refers to situations in which intravenous access needs multiple intravenous access attempts (≥ 2 punc-

ture attempts) due to various reasons ^[2-6]. However, relevant guidelines conservatively believe that two clinical nurses can be defined as DIVA after two puncture failures ^[7]. In different departments, the incidence of DIVA in children is different. In the operating room is 7–27% ^[8,9], and in outpatient and emergency departments is 7–44% ^[3,5]. While in hospitalized children is 10.44–36.8% ^[2,10].

2. Difficult peripheral venous access assessment tool

2.1. Difficult venous access rating scale

The DIVA rating scale is designed specifically for the pediatric population, aiming to identify the factors leading to the difficulty of intravenous catheter placement and predict the probability of failure of the first attempt of venous access; it includes three-variable, four-variable and five-variable rating scales. First proposed by Yen *et al.* (2008), a four-variable scale (venous accessibility, venous visibility, age, history of preterm birth) was ultimately determined when the score is ≥ 4 points, indicating a greater than 50% chance of failure at the first attempt at puncture ^[11]. In 2011, Riker *et al.* replaced “preterm birth history” with “NICU admission history” in Yen’s four-variable assessment tool to form a new tool, which was verified in the children’s emergency department ^[12]. Finally found that the DIVA three-variable scale and the four-variable scale could equally predict the first puncture failure rate. O’Neill *et al.* (2012) applied the four-variable assessment tool to predict the success rate of puncture in children aged 0–14 in the emergency department, but this tool did not perform reliability and validity tests, and it had inadaptability to children with different characteristics in the emergency department ^[13]. Brazilian scholars (2017) translated and verified the adaptability of the five-variable scale in non-Western cultures ^[14]. Later, Rizvi *et al.* (2022) combined the original DIVA assessment tool with a “history of difficult puncture” to form a modified DIVA tool and defined m-DIVA as a DIVA score ≥ 4 or a history of difficult puncture ^[15]. Now, the DIVA score has been verified in pediatric emergency settings, but Kanaley *et al.* (2023) applied the above DIVA assessment tool to hospitalized children, and the results showed that the DIVA score alone could not predict the success of the first attempt of peripheral venipuncture ^[16]. Therefore, the applicability of this tool in different child populations needs further study.

2.2 Peripheral vein assessment tool

The domestic rating standard for superficial vein vessels was first developed by Li *et al.* 2001 and patients’ veins were divided into four grades ^[17]. Nurses evaluate vein vessels before venipuncture to reduce vascular damage caused by puncture failure, but this tool was not tested for reliability and validity. Subsequently, the superficial vein rating table for children compiled by Zeng *et al.* (2016) shows a Cronbach’s α coefficient of 0.99, indicating good reliability ^[18]. However, it did not explain the relationship between the vein grade and puncture difficulty. The peripheral vein evaluation tool developed by Hallam *et al.* (2016) defined the quality of veins in terms of the number of palpable and visible veins ^[19]. Although the inconsistency of the subjective description of peripheral veins as “good” or “poor” in the past was corrected, the evaluation dimension was only evaluated from the number of visible veins. It was not comprehensive and did not reflect the specific characteristics of pediatrics. Hattman *et al.* (2018) revised the peripheral vein grading scoring tool, which includes 6 entries, each with a different score ^[20]. The total score is 7–21, and the higher the score, the more difficult the puncture. Yan *et al.* (2016) peripheral vein grading system ^[21] and the vascular grading evaluation standard by Xu *et al.* (2019) ^[22] both assessment scales not analyze the risk factors such as disease and nutritional status of patients, the vascular grading index still needs to be improved. The evaluation guidelines for peripheral venipuncture in children, on the other hand, included the child’s and family’s compatibility, the methodology for the development of the assessment guidelines is not clear and did not measure the reliability and validity ^[23]. Tang (2020) and 6 pediatric nursing experts jointly pre-

pared the rating standard for superficial vein vessels in pediatric wards, including 6 items, with a full score of 18^[24]. This scale was only applicable to the vascular assessment of hospitalized children younger than 5 years old, and its applicability to other ages and outpatient children needs further study.

3. Summary

To sum up, the quality of various assessment tools at home and abroad is uneven. Among those assessment tools, each has limitations and has not formed a unified standard. Some assessment tools have incomplete assessment content, or the scale has not been tested for reliability and validity and so on. Riker's DIVA scoring scale has been verified in pediatric emergency care in Western countries, but it has not been used in China, and its applicability to China needs to be studied. The evaluation of general venous conditions developed in China is not applicable to DIVA. In future, we can combine the advantages of foreign assessment tools based on evidence-based medicine and further establish an objective and systematic DIVA assessment tool so as to provide a professional basis for clinical nurses to predict children with DIVA, to improve the success rate of puncture and the medical experience of children.

Disclosure statement

The authors declare no conflict of interest.

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