Journal of Pediatric Intensive Care 2 (2013) 177–180
DOI 10.3233/PIC-13069
IOS Press

Formula estimation of appropriate urinary catheter size in children

Matjaž Kopač*
Department of Nephrology, Division of Pediatrics, University Medical Centre Ljubljana, Ljubljana, Slovenia

Received 29 January 2014
Revised 24 February 2014
Accepted 27 February 2014

Abstract. To perform proper and optimal catheterization, a urinary catheter of appropriate size has to be selected as the success of a procedure is often dependent on it. Catheterization of the urinary bladder is a common procedure in pediatric practice which is used for numerous diagnostic and therapeutic purposes. There are very few recommendations on how to choose the optimal size of a catheter on the basis of a child's age or weight. Based on a few published relationships between a child's age, body weight and urinary catheter size, as well as personal experience, the author has developed a formula for estimating urinary catheter size according to a child's weight that reads as follows: $Urin.Catheter(F) = \frac{Weight(kg)}{3} + 4$. Presented formula may prove useful in everyday clinical practice and especially in emergency settings.

Keywords: Urinary catheter, bladder, body weight, age, child

1. Introduction

Catheterization of the urinary bladder is a common procedure in pediatric practice. It is used in a number of circumstances for both diagnostic and therapeutic purposes. Diagnostic catheterization is performed in contrast-enhanced investigations (voiding cystography), for the collection of sterile urine samples for urinalysis and urine culture in case of suspected urinary tract infection, when a less invasive method of urine collection is not feasible, as well as for 24-hr urine collection for estimation of diuresis, quantitative proteinuria and metabolic evaluation in infants and small children who are unable to collect urine in a container. Therapeutic catheterization, on the other hand, is performed for decompression of acute urinary retention, regular bladder emptying (intermittent catheterization of neurogenic bladder), as well as for intravesical drug administration [1].

*Address for correspondence: Dr. Matjaž Kopač, Department of Nephrology, Division of Pediatrics, University Medical Centre Ljubljana, Bohoričeva 20, SI-1000 Ljubljana, Slovenia. Tel.: +386 1 522 3842; Fax: +386 1 522 9620; E-mail: matjaz.kopac@siol.net.

The procedure is relatively safe when contraindications for catheterization are taken into account (pelvic fractures, known trauma to the urethra or blood at the meatus [2]), and when it is performed by an experienced staff and using an appropriate urinary catheter size. Complications are rare, but can occur and include hematuria, creation of false passages, urethral perforation, urethral strictures, paraphimosis and iatrogenic infection [1].

Currently, the size of the urinary catheter is selected according to child's age [1,3] as well as according to child's body weight [4,5]. Sometimes these tables are not immediately available. A formula for estimating urinary catheter size according to a child's weight would be of help in everyday practice and has been developed and is presented in this article.

2. Material and methods

Currently, the size of the urinary catheter is selected according to a child's age. This relationship is presented

2146-4618/13/$27.50 © 2013 – IOS Press and the authors. All rights reserved

Table 1
Urinary catheter size according to a child's age group [1]

Child's age group	Newborns	Infants	Prebupertal Children	Adolescent
Urinary catheter size (F)	4–6	6–8	10–12	14

F – French (international unit for urinary catheter size).

Table 2
Urinary catheter size according to a child's age group [3]

Age	Praematurebaby	Newborn baby	3 months–4 years	6 years	8 years	>12 years, adolescent
U. catheter size (F)	5	6	8	10	12	14

F – French (international unit for urinary catheter size).

Table 3
Urinary catheter size according to a child's body weight [4,5]

Body weight	Newborn/small infant 3–5 kg	Infant 6–9 kg	Toddler 10–11 kg	Small child 12–14 kg	Child 15–18 kg	Child 19–22 kg	Large child 24–30 kg	Adult >32 kg
Urinary catheter size (F)	5–8	5–8	8–10	10	10–12	10–12	12	12

F – French (international unit for urinary catheter size).

in Table 1 [1] and Table 2 [3]. On the other hand, a table is available that estimates child's urinary catheter size according to body weight [4,5] and is presented in Table 3.

A formula exists for estimating a child's body weight according to age: Body weight (kg) = 2 × (age [yr] + 4) [6]. This formula applies to children between 1 and 10 yr of age, and is a very useful tool especially in emergency situations, since it allows estimation of a child's weight before his/her arrival at the hospital. In this way the appropriate equipment, including the urinary catheter, as well as drugs and fluids, which are mostly given according to a child's weight, can be prepared in advance.

With the aim of estimating urinary catheter size according to body weight, the estimated calculated body weight was interpolated using the above-mentioned formula, and the results are presented in Figure 1.

Subsequently, a formula for estimating urinary catheter size according to child's body weight was developed, taking into account the relationship between urinary catheter size and body weight presented in Figure 1. First a preliminary general formula was developed to describe the relationship between urinary catheter size and body weight. As can be seen from Figure 1 this relationship is linear therefore the proposed preliminary formula could be: $UrinaryCatheter(F) = \frac{BodyWeight(kg)}{k} + n$, where k is a regression coefficient (representing in fact the slope of the curve in the diagram) and n is a value (representing a correction factor) that has to be added to the equation. A value k can be obtained by dividing a value on y-axis (Urinary catheter size – axis) by a corresponding value on x-axis (Body weight – axis): $k = \frac{\Delta(UrinaryCatheter)}{\Delta(BodyWeight)}$, for example: $k = \frac{12-8}{24-12} = \frac{4}{12} = \frac{1}{3}$. A value n can then be obtained by solving a simple equation by inserting corresponding values: $n = UrinaryCatheter(F) - \frac{BodyWeight(kg)}{3}$, for example: $n = 10 - \frac{18}{3} = 10 - 6 = 4$.

3. Results

With the aim of estimating urinary catheter size according to body weight, the estimated calculated body weight was interpolated using the above-mentioned formula, and the results are presented in Figure 1.

Subsequently a formula for estimating urinary catheter size according to child's body weight was developed, taking into account the relationship between

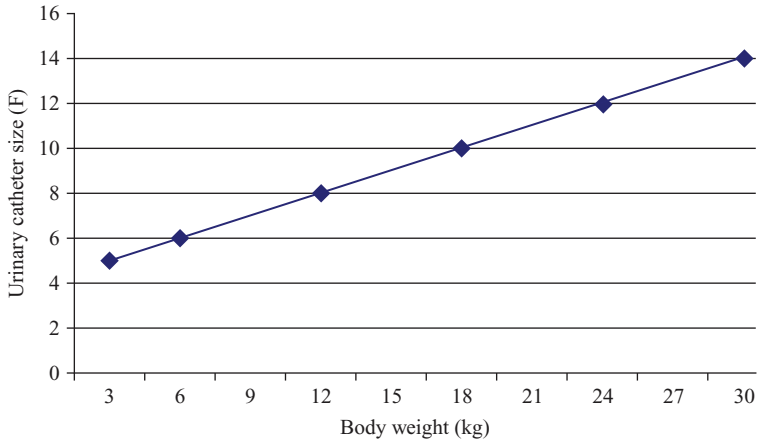

Fig. 1. Graphic presentation of relationship between urinary catheter size and child's body weight.

urinary catheter size and body weight presented in Figure 1. The proposed formula reads as follows:

$$UrinaryCatheter(F) = \frac{BodyWeight(kg)}{3} + 4$$

The results obtained using this formula for catheter size (expressed in the international unit F - French) should be rounded to the nearest available urinary catheter size and used only for children weighing up to 30 kg. Thereafter the urinary catheter sizes for adults can be selected. For example, if a child's body weight is 12 kg, we choose urinary catheter no. 8 because $\frac{12}{3} + 4 = 4 + 4 = 8$.

4. Discussion

Choosing a urinary catheter of appropriate size is an important first step in bladder catheterization, as the success of the procedure could depend on it. When a too small catheter is chosen, the urine may leak around the catheter and the diuresis estimation can be underestimated. On the other hand, when a urinary catheter that is too large is chosen, it may irritate or even hurt the sensitive urethral mucosa. Currently, the size of the urinary catheter is selected on the basis of tables, which estimate the catheter size according to child's age [1,3] as well as according to child's body weight [4,5]. The formula for estimating urinary catheter size according to child's body weight presented in this article may be of assistance, especially in emergency settings, especially for physicians that don't regularly perform urinary catheterization and are therefore not familiar with published tables showing relations between age or weight of child and urinary catheter size. The presented formula is based on published relations between urinary catheter size and child's age and body weight [1,3,4,5].

Body weight is one of the basic vital physiologic parameters, which can be determined quickly, and easily in every child who is admitted to hospital or in an outpatient clinic. But if there is no time for weighing the child properly, such as in emergency situations, the formula for estimating child's body weight according to age mentioned in the Methods section can be used [6]. In such situations it may be more convenient to use the formula for estimating urinary catheter size according to weight as well. A clear limitation of this approach is that children of similar age may differ significantly in body weight. The formula seems to be applicable only in underweight to average-built children, because in extremely obese children it can overestimate the proper size of the urinary catheter.

In conclusion, the presented formula for estimating urinary catheter size according to a child's weight might prove useful in everyday clinical practice and especially in emergency settings, taking into account the limitations for its use.

References

[1] Lacroix LE, Vunda A, Bajwa NM, Galetto-Lacour A, Gervaix A. Videos in clinical medicine. Catheterization of the urethra in male children. N Engl J Med 2010;363(14):e19.

[2] Shilkofski N, Procedures. Body fluid sampling. E. Urinary bladder catheterization. In: Robertson J, Shilkofski N, editors. The Harriet Lane Handbook. 17th ed. Philadelphia: Elsevier Mosby, 2005. p. 94.

[3] Custer JW, Rau RE. Pediatric parameters and equipment. In: Custer JW, Rau RE, editors. The Harriet lane Handbook. 18th ed. Philadelphia: Elsevier Mosby, 2009. inside title page.
[4] Chapter 12. Pediatric trauma. In: Hazinski MF, editor. Manual of pediatric critical care. 1st ed. St. Louis: Mosby-Year Book, 1999. p. 590.
[5] Broselow Pediatric Resuscitation Tape (adapted from). Lincolshire, IL: Armstrong Medical Industries; 2011. Product No: AE-4800.
[6] Biarent D, Bingham R, Rodriguez-Nuñez A, et al. European paediatric life support course manual. 2nd ed. Antwerp–Belgium: European Resuscitation Council (ERC); 2003. p. 7–9.