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Positioning and complications of umbilical catheters

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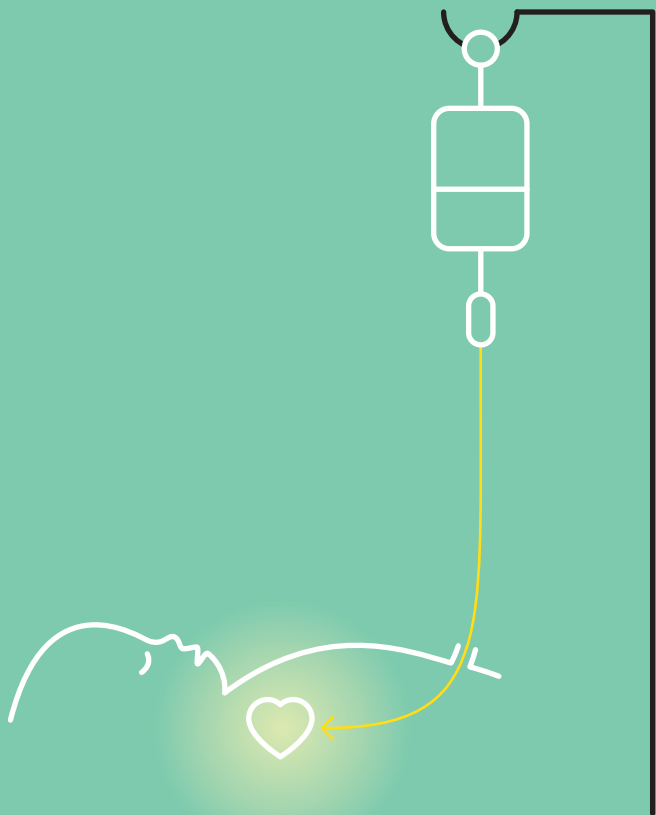


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PART I

Positioning of Umbilical Catheters

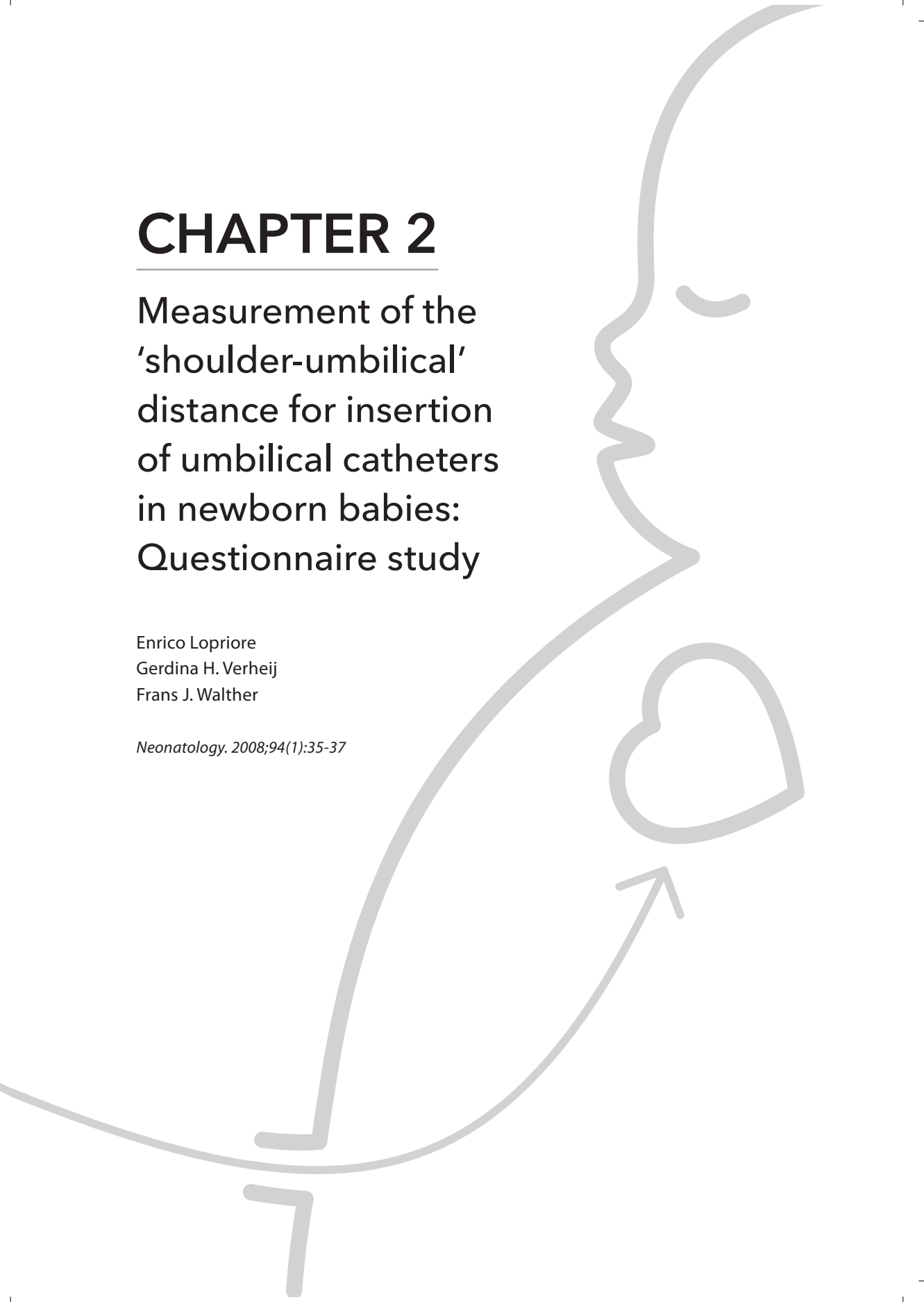


CHAPTER 2

Measurement of the 'shoulder-umbilical' distance for insertion of umbilical catheters in newborn babies: Questionnaire study

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Frans J. Walther

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ABSTRACT

Approximately 40 years ago, Dr. Peter Dunn introduced a simple method to determine the insertion length of umbilical catheters in neonates, by using the 'shoulder-umbilical' (S-U) length. Since then, various studies have reported a high rate of malposition of umbilical catheters. One of the possible reasons is that the method used to determine the S-U length varies among paediatric professionals. We performed a questionnaire study among 101 paediatric professionals in the Netherlands and found that the method used by the participants to measure the S-U length was highly inconsistent. Placement of an umbilical venous catheter in a too deep position may lead to potentially life-threatening complications. Therefore, uniformity in measurement is paramount for clinical and teaching purposes. Paediatric professionals using Dunn's definition to place umbilical catheters should adhere more strictly to the original description of the measurement of the S-U length.

INTRODUCTION

Placement of umbilical catheters is a common procedure in neonatal intensive care units. Umbilical venous catheters are required for fluid, medication and nutrition administration whereas umbilical arterial catheters are used for monitoring blood gases and blood pressure. The most common method used to estimate the correct insertion length of the catheters was described in 1966 by Dunn,¹ and requires the measurement of the 'shoulder-umbilical' (S-U) length in combination with the appropriate graph. However, various methods are currently being used to measure the S-U length, leading consequently to a different corresponding insertion-length of catheters. Incorrect measurement may lead to malposition of the umbilical catheters and potential complications such as thrombosis, pericardial or pleural effusions and arrhythmias.² The aim of this study was to examine the variations between paediatric professionals in various centres in the Netherlands in determining the S-U length.

PARTICIPANTS, METHODS, AND RESULTS

We developed a questionnaire in which the method used to measure the S-U had to be determined (Figure 1).

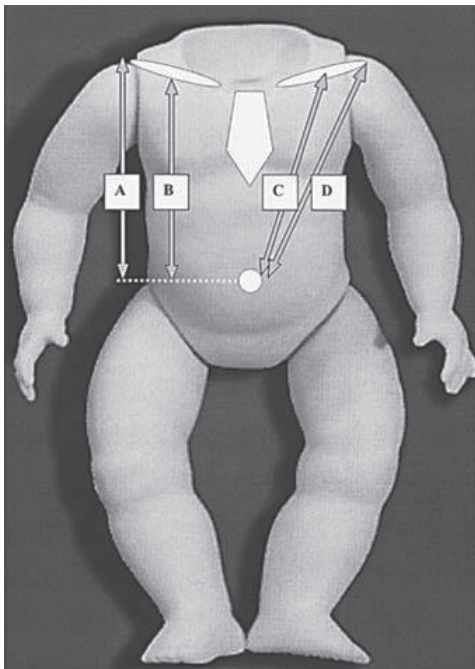


Figure 1. Measurement technique used to determine the S-U length.

The S-U length method of Peter Dunn is routinely used in all participating centres. We asked the participants to select which technique they used to determine the S-U length (A, B, C or D). The response rate was 69% (101/147). A total of 101 paediatric professionals (45 paediatric consultants and 56 paediatric senior house officers) from five university hospitals in the Netherlands and one general hospital participated in the study. Fourteen participants (14%) chose method A, 8 (8%) method B, 39 (39%) method C, and 40 (40%) method D. The technique used to determine the distance between shoulder and umbilicus varied greatly between the various centres and between the paediatric professionals within the same institution (Figure 2).

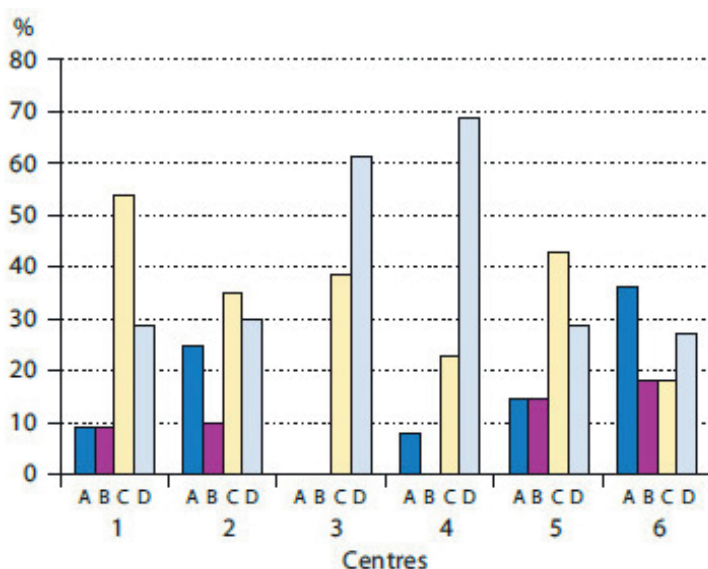


Figure 2. Technique (A, B, C or D) used in the 6 participating centres to determine the S-U length (centre 1 represents the general hospital; centres 2-6 represent the five university hospitals).

The technique used varied also between consultants and senior house officers. Seven consultants (16%) chose method A, 4 (9%) method B, 13 (29%) method C, and 21 (47%) method D. Seven senior house officers (13%) chose method A, 4 (7%) method B, 26 (46%) method C, and 19 (34%) method D. In the Netherlands, umbilical lines are usually put in by the senior house officers.

COMMENT

This study shows that the method used by paediatric professionals to measure the S-U length for placement of umbilical catheters is inconsistent. The S-U length was defined

by Dunn as 'the distance between the top of the shoulder over the lateral end of the clavicle and a point vertically beneath it that was level with the centre of the umbilicus', corresponding thus to option A.¹ The charts required to determine the distance at which the catheter should then be positioned are based on this original definition.¹ However, only 14% of participants report using this method. Most participants (40%) used method D.

According to the theorem of Pythagoras [http://en.wikipedia.org/wiki/Pythagorean_theorem], length measurement in method D is equivalent to the hypotenuse (the hypotenuse of a right triangle is the triangle's longest side; the side opposite the right angle) and results thus in a deeper insertion length. For a given term infant with a birth weight of 3.5 kg, the discrepancy in measure between method A and D is 1.5 cm (SU distance of 17 and 18.5 cm for methods A and D, respectively), which corresponds approximately to 1 vertebral body count on an anterior-posterior chest radiography. A mean difference of 1 vertebral body may result in malposition of an umbilical catheter.³ The study of Ades et al. shows that umbilical lines positioned using the S-U length method tend to overestimate the correct insertion length.³ Our data suggest that this incorrect positioning may partly be due to incorrect measurement of the S-U length. Placement of an umbilical venous catheter in a too deep position may lead to potential complications such as intracardiac thrombosis, myocardial perforation, pericardial effusion and arrhythmias.² Therefore, uniformity in measurement is paramount, not only for teaching purposes, but also for clinical reasons. However, even if the distance is measured more consistently, radiological investigations (chest radiography or echocardiography) after insertion to verify placement are still required. Nevertheless, paediatric professionals using Dunn's definition to place umbilical catheters should adhere more strictly to the original description of the measurement of the S-U length.

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