Selected Summaries

Needle Length and Injection Technique for Efficient Intramuscular Vaccine Delivery

[Groswasser J, Kahn A, Bouche B, Hanquinet S, Perlmuter N. Needle length and injection technique for efficient intramuscular vaccine delivery in infants and children evaluated through an ultrasonographic determination of subcutaneous and muscle layer thickness. Pediatrics 1997; 100: 400-403].

The relationship between reactogenicity and immunogenicity of vaccine with route and site of injection is well documented. Both injection technique and needle length are crucial for ensuring proper intramuscular delivery and thus are directly related to vaccine safety and immunogenicity. To determine the optimum needle size for intramuscular injection and eventually to make a correlation between needle length and appropriate injection technique, one must have accurate data on morphometric characteristics of healthy people with respect to subcutaneous tissue (SCT) and muscle layer (ML) thickness. Hence the present study was conducted with the aim to obtain SCT and ML thickness at two sites recommended for vaccine injection, i.e., thigh and deltoid in infants and children at the age of primary and subsequent booster immunizations.

Forty infants, median age 12 weeks (range 9-27 wks) and 18 toddlers, median age 79 weeks (68-88 weeks) were investigated. Tissue thickness at deltoid and anterolateral part of thigh was measured using high frequency, real time ultrasonograph with 6 cm long, 75 Hz transducer. All children were in good health, without a history of upper or lower limb injury or any neurological and muscular disease. Morphometric characteristics of infants and children fell between 10th and 50th percentiles according to age and gender of Belgian normal growth curves which are similar to standard NCHS curves.

Over anterolateral part of thigh, skin to bone depth was a 17 mm in both infants and toddlers. In infants SCT thickness was approximately 7.2 mm (range 4.8 -12 mm) regardless of the side examined or the gender of the child. In toddlers, the skin to muscle depth had a mean value of 7.5 mm (range 4.8-11 mm) quite similar to that observed in infants. In infants the quadricep thickness averaged 9.3 ± 0.3 mm (mean ± SD) and was similar on both sides (a median of 8.7 and 8.9 mm on the right and left sides, respectively). The quadriceps muscle was slightly thicker in toddlers, with median value of 9.3 mm. In the deltoid region evaluated only in toddlers the mean SCT thickness was 4.9 mm (range 3.6 - 6.9 mm) with a mean ML thickness 5.8 mm (range 3.4 - 7.5 mm). The average skin to bone length was 10 mm (range 7 -14.2 mm).

According to these measurements, 16 mm (5/8 inch) needle should be used if technique used for injection is stretching of skin flat between finger and thumb followed by pushing the needle at 90° angle through skin. On the other hand, a 25 mm needle suits the injection technique widely used in United States, *i.e.,* bunching of tissue at injection site and then injecting. The use of 16 mm needles should be avoided if technique of bunching of tissue is used es-

pecially for adsorbed vaccines to minimize the risk for subcutaneous delivery. The study demonstrated that difference between SCT thickness in infants and children is minimal with approximately the same skin to bone length over the anterolateral part of thigh. Therefore, the injection technique is the most important parameter in ensuring efficient intramuscular vaccine delivery and consequently it determines the needle length.

Comments

Intramuscular injection is the preferred route of administration of aluminium adsorbed vaccines *{e.g.,* diptheria, tetanus, pertussis and inactivated polio virus (DTP-IPV), hepatitis A and hepatitis B vaccines) because superficial administration leads to increased incidence of local reactions(l). A better immune response for intramuscular injection compare to subcutaneous route has been seen for several vaccines including hepatitis B and rabies(2,3). Guidelines concerning the choice of injection technique and needle length have been presented. Two injection techniques are currently recommended. The first widely used in United States, requires bunching of thigh muscle at the injection site to increase muscle mass and to minimize the chance of striking bone(l). The second recommended by WHO, suggests stretching the skin flat between the finger and thumbs and pushing the needle down at a 90° angle through the skin(4). With respect to needle length, both WHO and the Committee on Infectious Diseases of the American Academy of Pediatrics support the use of 7/8 inch (22 mm) or longer needles for intramuscular delivery(4,5). The present study clearly demonstrates that needle length should be different for each of the above described techniques to decrease the incidence of subcutaneous injection or striking the bone.

Further, this study carried out on nutritionally comparable Belgian infants demonstrates that there is minimal difference in the SCT thickness between infants and children. Therefore needle length used would primarily depend on injection technique used. Although comparable in infants and toddlers in the Belgian study, subcutaneous tissue thickness and muscle layer thickness may be variable in different subgroups of the population. Moreover obesity is becoming commoner in a number of Western countries(6) and for various grades of malnutrition in developing countries like ours no such conclusions can be made.

Some workers feel that the use of 16 mm needle causes more redness and swelling than the use of a 25 mm needle but the incidence of pain or systemic symptoms are independent of needle length(7). The implications of these results are difficult to analyze because in most vaccine trials the injection technique is not described(8). The technique of bunching of skin to increase the muscle mass should be practised in countries where majority of children are malnourished to minimize the chances of striking the bone. However, it should be stressed that optimizing factors such as injection site, technique and needle size will not eliminate reactions completely. Therefore, practitioners should use their judgement about where and how to inject and adjust needle size appropriately(l,9). If problems are encountered with a particular injection technique and needle size, a change of either should be considered.

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Furosemide in Bronchial Asthma

[Ono Y, Kondo T, Tanigak T, Ohta Y. Furosemide given by inhalation ameliorates acute exacerbation of asthma. } Asthma 1997; 34: 283-289].

The search for an ideal drug to effectively combat acute exacerbations of asthma continues. Inhaled furosemide has protective effect against many bronchoconstrictor agents namely exercise(l), cold air(2) and ultrasonically nebulized distilled water(3). A double-blind, placebo controlled randomized study was caried out to demonstrate the efficacy of inhaled furosemide in acute exacerbations of bronchial asthma.

Forty patients with acute exacerbation of asthma who had not received any inhaled beta-2-agonists during 60 minutes before the study and had been on more than one year follow up were randomly assigned to receive either furosemide (10 mg/ml in distilled water containing sodium hydroxide, pH 8.60 - 280 mosm) or placebo (normal saline, pH 8.67, 288 mosm) aerosol. Both groups received a bolus intravenous injection of hydrocortisone succinate and an aminophylline infusion given over 90 minutes. Thirty minutes after start of aminophylline infusion either 20 mg furosemide or 2.0 ml of physiological saline was given by a jet nebulizer. Spirometry was performed at 0, 30, 60 and 90 minutes during aminophylline administration and the forced vital capacity (FVC) and forced expiratory volume at 1 sec (FEV_1) and peak expiratory flow rate (PEFR) were deter-

mined. The baseline forced expiratory volume at 1 sec (FEV_1), peak expiratory flow rate (PEFR) and serum concentrations of theophylline did not differ between the two groups. Thirty minutes after study, *i.e.,* just before the inhalation of furosemide or placebo the FEV_1 from the baseline did not significantly differ from the baselines of each group. A significant increase in FEV_1 and PEFR in the furosemide group was seen at 60 minutes and was still evident at 90 minutes. There was no difference between the two groups regarding previous medication, severity and type of asthma.

Comments

The bronchodilatory effects of inhaled furosemide in bronchial asthma exacerbations has not been previously investigated in detail. This current study proved its efficacy when used in adults with acute asthma in conjunction with steroids and intravenous theophylline. Its additive bronchodilatory effects when used with salbutamol has been shown in a previous study(4). It is still unclear how effective inhaled furosemide would be when used alone. Karpel *et al.* employing very few patients did not substantiate the role of inhaled furosemide alone in flare ups of bronchial asthma(5). Many large placebo controlled trials especially in children would be needed before its exact role can be established. Further its pharmacological mode of action is still unclear. Effect on cyclooxygenase metabolism(6), direct stimulation of Cafferent nerve fibres(7), blocking release of substance P(8) and changing neural conduction by ionic transport in nerve fibres(9) are some of the postulated mechanisms of action of inhaled furosemide. However, till the exact pharmacology of the drug is clearly elucidated, its use will remain largely experimental. Lack of side effects of inhaled furosemide namely tachycardia and hypertension which is seen with inhaled beta-2-agonists may prove advantageous.

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