Selected Summaries

Temperature Measurement in Febrile Intensive Care Patients: Which Method?

[Schmitz T, Bair N, Falk M, Levine C. A comparison of five methods of temperature measurement in febrile intensive care patients. Amer J Crit Care 1995, 4: 286-292]A clinically useful temperature measurement method should correlate well with the body's core temperature. None of the previous studies have compared various methods specifically in febrile critically ill patients. Therefore, to determine relationship among different temperature measurement methods in febrile intensive care patients, the authors obtained temperature readings in rapid sequence from an electronic thermometer for oral and axillary temperature, rectal probe, infra-red ear thermometer on "core" setting, and pulmonary artery catheter, approximately every hour during the day and every 4 hours at night. A total of 113 sets of temperature measurements were obtained in 13 patients with pulmonary artery catheters and with temperatures of >37.8°C The highest correlation with pulmonary artery temperature was seen with rectal (r=0.78) and lowest with axillary (r=0.49) temperature. Rectal temperature showed closest agreement with pulmonary artery temperature, the limit of agreement being 0.04°±0.72° C. This was followed by oral (0.19±0.8°C), ear based (0.21±0.97°C), and axillary temperatures (—1.12±1.6°C). Rectal and earbased temperatures were most sensitive (sensitivity 0.87 and 0.86, respectively) in detecting temperatures greater than 38.3°C and had the least chance of a false negative reading. Likelihood ratio for detecting hyperthermia was 2.46 for rectal and 1.97 for ear-canal temperature whereas no patient with elevated temperature was classified as febrile by axillary temperature. Similarly negative likelihood ratio was least for rectal (0.22) and maximum for axillary (0.86) temperature. Authors conclude that rectal temperature measurement correlates most closely with core temperature. If the rectal site is contraindicated, oral or ear-based temperatures are acceptable. Axillary temperature (AT) does not correlate well with pulmonary artery temperature. These results underscore the importance of consistency in method when establishing temperature trends, and of awareness of method when interpreting clinical data.

Comments

Accuracy of temperature measurement is essential from clinical and financial standpoints. Falsely low reading may delay needed treatment. Whereas falsely elevated reading may prompt unnecessary sepsis workup and use of antibiotics. This study, although on adult subjects, suggests a close relationship among rectal (RT), ear canal (ET), oral (OT) and pulmonary artery temperature (PAT) readings and supports the clinical use of RT to assess for the presence or absence of fever. OT or ET may be used when RT is contraindicated. In febrile patients with temperatures of 38.3 °C or greater, the ET slightly underestimated the degree of fever. The results of this study also support the widely held belief that AT is a poor indicator of core temperature and is not clinically useful in differentiating febrile from afebrile patients. These findings are at variance from observations made in a recent study(l). The limit of agreement

between rectal and axillary temperature in this study on children was 1.04°C±0.45° C. The authors suggest that axillary temperature plus 1°C can be used as a good guide to rectal temperature. However, even with the suggested correction (AT+1°C = RT), the corrected AT deviated from measured RT by ±1°C. This margin of error may not be acceptable in critically ill patients where a rectal temperature of 39 °C requires a septic workup and initiation of antibiotics, whereas a wrongly estimated temperature of 38° C may delay necessary therapeutic intervention.

Limitations of the current study include: small sample size, use of only one brand of thermometer for each site, lack of testing of thermometers and^pulmonary artery catheters to verify accuracy, and lack of formal testing of data collectors' interobserver reliability. Further investigations in this area on critically ill children would be of interest. Use of a larger sample size would also permit establishment of fever cutoffs for OT, AT, and ET in the unadjusted mode.

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Normal Saline Instillation Before Suctioning: Helpful of Harmful?

[Raymond Sj. Normal saline instillation before suctioning: Helpful or harmful? A review of the literature. Crit Care 1995, 4: 267-271.]

To remove secretions and maintain a patent airway for optimal ventilation and oxygenation, endotracheal suctioning is a necessity. Nevertheless, it is associated with several unintended, potentially life-threatening consequences and complications. Several techniques intended to minimize potential complications of endotracheal suctioning have emerged over the past few years. One such technique is the routine instillation of 3 to 10 ml of normal saline into the endotracheal tube before suctioning. Although this technique has become a common clinical practice, published literature reveals that evidence substantiating its benefits is lacking. Almost all these studies are on adult subjects; no study on children could be found. Typical guidelines for ET suction state that purpose of normal saline instillation is to lubricate the catheter and to stimulate cough for mobilization of secretions. Other suggested advantages of normal saline instillation are loosening of thick secretions, increased secretion clearance, and dilution of secretions. Let us examine if this indeed is substantiated by scientific studies.

Instillation of normal saline is not effective in thinning or liquefying secretions and does not affect secretions beyond the mainstem bronchi. Investigation using technetium 99m labeled normal saline revealed that all of instilled saline remained in the treachea and mainstem bronchi; none of it reached the periphery of the

lungs after a 30-minute period(l). Moreover, only 10.7% of the normal saline instilled in the dogs (n = 5) and 18.7% of that instilled in human subjects (n = 2) could be retrieved by suctioning(l). Replication of this study using a larger, more diverse human patient population is needed.

The claim that normal saline instillation enhances the removal of secretions, through stimulation of a cough reflex and/or decreased adherence of secretions to the endotracheal tube, has not been disproved. The fact that normal saline instillation elicits a cough, which in turn may loosen secretions, is well established(2). Grey *et al.(3)* also noted that patients coughed more frequently during suctioning after saline instillation, though stimulation by the catheter alone also elicited a comparable cough in intubated patients. Whether this results in increased secretion clearance has not been proven.

Potential harmful effects of saline instillation during suction include interference with alveolo-capillary oxygen exchange with resultant decrease in oxygen saturation, increased rate of respiratory infections and raised intracranial pressure. A trend toward lower PaO_2 values 20 minutes after instillation of increasingly larger amounts of saline *(i.e.,* 5 and 10 ml) was identified in adult open heart surgery patients(4). On the otherhand, no statistically significant difference in heart rate, blood pressure, respiratory rate, or arterial blood gas values was documented between endotracheal suctioning with or without normal saline instillation immediately after and 15 minutes after suctioning in critically ill adults(3). Ackerman and Gugerty(5) discovered a decrease in oxygen saturation immediately after suctioning, whether a saline bolus was instilled or not. SaO_2 values of patients who received a 5 ml normal saline instillation were significantly lower at 45 sec, and 1, 2, 3 and 5 minutes after suctioning as compared to SAO_2 of patients who received no saline bolus. The actual drops in SaO_2 noted, however, were no greater than 1.04% and therefore, clinically insignificant. More recently using a more rigorous repeated measure design and larger sample size (n = 40), Ackerman(4) found that at each time after suctioning, normal saline instillation had a negative effect on oxygen saturation compared with no saline administration. However, the average changes in oxygen saturation were less than 1% and clinically insignificant.

In conclusion, available data does not suggest any short or long term benefit from the practice of normal saline instillation with suctioning. However, only one researcher had concluded that this procedure caused harmful effects(4). On the balance, it may therefore, be recommended that normal saline instillation before suctioning should be used in practice only after the need for this intervention has been well established in an individual patient (by quality of secretions, quality of breath sounds, quality and effectiveness of cough, oxygenation, and ventilatory status) and the patient's response to it has been carefully evaluated. Until it is clearly demonstrated that a physiologic benefit accrues from this procedure, it should not be used as a routine or standard clinical practice.

Alternative approaches of removing dried secretions from artificial airways, namely, nebulizer treatment, heating and humidification of the airways of intubated/tracheostomized patients, promoting optimal systemic hydration in an effort to ensure adequate pulmonary hydration and use of mucolytic agents should be considered. Although no single method is exceptionally effective, a combination approach may provide more success. Future research should focus on the effec-

tiveness of combination approaches.

Future research to determine conclusively whether a normal saline bolus before suctioning is harmful to patients shortly after instillation, should incorporate partial pressure of oxygen of venous blood and venous blood saturation of oxygen alongwith PaO_2 and SaO_2 as additional short term outcome measures. Long term benefits and effects of normal saline instillation also should be studied. These should include evaluation of chest radiography changes, and incidence of atelectasis and pneumonia.

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Sunit Singhi,
Additional Professor,
Department of Pediatrics,
Post Graduate Institute
of Medical Education and Research,
Chandigarh 160 012.

PCR for *Mycobacterium tuberculosis*

[Smita KC, Starke JR, Eisenach K, Ong LT, Denby M. Detection of Mycobacterium tuberculosis in clinical specimens from children using a polymerase chain reaction. Pediatrics 1996, 97:155-160.]

The usefulness of the polymerase chain reaction (PCR) using the insertion sequence IS6110 as the target for DNA to detect *Mycobacterium tuberculosis* in clinical specimens from children was evaluated. This was a prospective, controlled, blinded study comparing PCR on clinical specimens, mycobacterial culture, and clinical diagnosis.

Sixty-five hospitalized children were evaluated, 35 with tubercular disease and 30 controls. Cases were defined by culture and/or specific clinical criteria. Controls included patients with tubercular infection but no detectable disease as well as patients free of tubercular infection and disease.

PCR had sensitivity of 40% and specificity of 80% compared with clinical diagnosis. Mycobacterial culture had a sensitivity of 37%. The combination of culture and PCR identified 19 of 35 children (54%) with clinically diagnosed tuberculosis. There were six children with false positive PCR results; one had tubercular infection without disease, two had *Mycobacterium avium* lymphadenitis and three had diagnoses unrelated to tuberculosis.

The sensitivity of PCR is comparable to that of culture for detecting *M. tuberculosis* in children, and may strengthen and hasten the clinical diagnosis in culture-negative patients. However, because of the limitations in specificity, the results of PCR alone are insufficient to diagnose tuberculosis in children. Although ongoing refinements in PCR techniques should improve the specificity of this test, epidemiologic and clinical information continue to be the most important consideration in the diagnosis of tuberculosis in culture-negative children.

Comments

Tuberculosis continues to be a major killer of children in the developing countries in general and in children with HIV infection in the developed countries. According to WHO, more cases of tuberculosis occured in the world in 1995 than in any other year in history. One of the reasons for the high prevalence and mortality is the difficulty in accurate diagnosis since the clinical presentation can be nonspecific. In adults, the diagnosis can be established by demonstrating AFB in the sputum. With meticulons technique, conventional methods as well as with fluorescent staining, the positivity rate is fairly high. In cultures, as many as 80% patients may be positive, although the result by conventional techniques take several weeks.

Unfortunately sputum samples cannot be obtained in most children. Hence, the successful application of a very sensitive method, the PCR testing for *Mycobacterhim tuberculosis* in adults, raised the hopes of its utility in the pediatric population too. Investigation of PCR for detecting *M. tuberculosis* in children has been limited for several reasons. First, being an expensive test it is available mainly in the developed countries where the incidence of TB is low. Second, collection of consecutive early morning gastric aspirates requires hospitalization for at least 3 days, which is more costly and inconvenient than the collection of sputum specimens from adults in outpatient settings. Finally, the case definition for pediatric tuberculosis is based on epidemiologic and clinical information (because of lack of a sensitive laboratory diagnostic test), so comparison with a true "gold standard" is impossible.

False-positive results are known to be a problem with the PCR technique, both in research and hospital laboratories. There are two recognized explanations for false-positive PCR results. The most common problem is carry over of amplicons from previous reactions (even when the laboratory activities are well separated from each other). Another source of false-positive PCR results is cross-contamination with *M. tuberculosis* DNA isolated from positive clinical samples or the positive control sample during the processing procedure.

Early studies found PCR to be highly specific. However, recently false-positive PCR results have been reported from six of seven participating laboratories with rates ranging from 3% to *77%.* In clinical practice, false-positive results could halt a clinical evaluation, obscure the true diagnosis, and obligate a patient to lengthy and unnecessary treatment. The procedures for PCR testing are in a state of evolution. Continuous improvement in PCR techniques may be expected and should increase the sensitivity and specificity of this method. Till such eventuality, the usual laboratory in conjunction with clinico-epidemiologic information should continue to guide us in preference to costly 'Hi-Tech' investigations.

Krishan Chugh,
Consultant, Department of Pediatrics,
Sir Ganga Ram Hospital,
New Delhi 110 060