

mobile table would accomplish the authors' goal, with minimal interference in patient care. Such a practice could also be standardized, allowing for situations in which placing items on the patient's chest is not practical (*e.g.*, pediatrics).

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In Reply:

We appreciate the comments of Chalifoux and Feuer regarding our recent *Images in Anesthesiology* article.¹ We agree that identifying a specific site to isolate contaminated items is the key point, and that anesthesiologists may choose different options in meeting the goal. In our experience, we have found the chest to be a convenient location that allows us to keep our patient under continuous direct vision. We have not found the towel containing the contaminated equipment to interfere with auscultation and confirmation of endotracheal tube placement, and the towel allows for easy and rapid removal of the equipment after placement is verified. Using the anesthesia machine is an alternative, but we find this requires turning away from the patient, although we have colleagues who prefer that configuration. We agree that the chest is not ideal for small pediatric patients, but in that case there is generally room on the operating table for the towel. A Mayo stand or similar mobile tray is an excellent alternative, but requires additional workspace and may not be convenient in all anesthetizing locations. The crux of our proposal is to have a convenient space clearly identified as dirty to reduce anesthesia workspace contamination after intubating a patient. Anesthesia providers should create a systematic approach that works for their unique set of circumstances.

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Neurotoxicity: Rats *versus* Neonates

To the Editor:

We just finished reading, in the March 2012 issue, the excellent editorial by Dr. Davidson entitled "Neurotoxicity and the Need for Anesthesia in the Newborn."¹ We wish to make a few comments. It is quite true; neonates have no explicit memory and when receiving no anesthesia for a particular surgical procedure (*i.e.*, patent ductus arteriosus) will never remember what took place should they survive. These patients need to be immobile (muscle relaxant only) to suit the surgeon, but do they really need an analgesic to cloud their minds when the surgeon makes his incision? Is the central nervous system and brain at this moment really intact and mature to perceive pain sensation during an operation? Because neonates are very small, underweight, and not mature at this age, why make them totally unconscious or even semiconscious? The nervous system and brain are not developed to any great degree, so they won't feel anything. In the late 1960s and middle to late 1970s,²⁻⁴ neonates undergoing ligation of patent ductus arteriosus were semiconscious or totally conscious, had a muscle relaxant, had no narcotic for pain nor sedative and still survived with no neurotoxicity and no bad memories after growing up. These neonates showed no signs of distress during their procedure. One does not need a volatile anesthetic, potent narcotic, propofol, or other sedatives. If an anesthesia provider is worried about neurotoxicity of anesthetic drugs and agents, then the provider shouldn't administer the drugs. Performing research on animals such as rats and finding that certain medications and anesthetics cause neurotoxicity cannot or should not be extrapolated to humans. This research should be carried out in humans to confirm the hypothesis. It may be unpopular to say or suggest that neonates do not always need a hypnotic agent or such, but the fact remains many do not. Anesthesia providers (clinicians) must decide their technique based on factors such as patient height, weight, age, American Society of Anesthesiology class, surgical procedure, risk, and outcomes.

Again, data based on rat experiments⁵ should not be extrapolated automatically to humans. More research on humans is needed. The article³ was presented at the World Congress of Anesthesiology in 1976, Mexico City. The only question to arise was, "Did the neonate feel any pain?" The answer at the time was the same as now: "Does the neonate have a developed central nervous system and brain to perceive pain?" Is it developed? We do not know the exact answer to this very day. So the quandary still exists, and rat studies will not tell us emphatically, but if drugs and anesthetics are neurotoxic, then the clinician had better be careful in his decisions. The clinician must also be aware that administering an opioid to a very sick neonate could cause hypotension leading to a low pressure, which then leads to poor perfusion to vital organs, especially the heart and lungs, and poor perfusion to the central nervous system and brain. That is *neurotoxicity*. Also poor perfusion to the intestinal tract, which could

lead to bowel necrosis. Sedatives and potent volatile inhalation anesthetics might cause the same effect in sick neonates.

To reiterate, the author of the editorial is quite correct in stating that neonates may not need anesthetics or analgesics for various surgeries because of undeveloped central nervous system and brain functions, even though four⁶⁻⁹ of his references state the opposite. Those studies that led to publications took care of infants (babies) and not true neonates. Their papers⁶⁻⁹ plainly show on the day of surgery, their weight, gestation were all in the small baby stages and not *true* neonates, which in the true sense is an infant within the first 4 weeks of life and not weighing more than 3–4 kg in some instances. The study by Gruber *et al.*⁹ deals with babies 3–4 months old and weighing 4.5–5.1 kg. The Anand patients⁶⁻⁸ weighed approximately 3.5–3.6 kg, which is far from a neonate's weight. Gruber's patients⁹ had cardiac surgery *via* cardiopulmonary bypass. No wonder they had general anesthesia. Therefore, these authors mixed up the definitions of neonates and babies like apples and oranges.

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In Reply:

The editorial did not intend to argue that infants or neonates don't perceive pain and thus don't need analgesia and anesthesia for surgical procedures.¹ There is now very good evidence that painful stimuli increase cortical activation in preterm and term neonates.² The aim of analgesia therefore is not just to "cloud their minds," but to reduce acute distress and the morbidity associated with physiologic and behavioral responses, and also to minimize increases in activity in nociceptive pathways that can produce long-term changes in neuronal architecture and subsequent behavior.³ Neonates should be provided with effective analgesia for surgical procedures.

It is difficult to know the relevance of some of the studies quoted by Dr. Lippmann. Many aspects of care have changed since the 1970s. In 1976, Dr. Lippmann reported an acute mortality of 38%,⁴ and 3 of the 19 infants who survived to discharge also had neurologic impairment.⁵ Such mortality would be unacceptable now. However, more recent studies find significant rates of neurosensory impairment after surgical patent ductus arteriosus closure.⁶ These findings emphasize the enhanced sensitivity of the developing nervous system to early life insults, although the exact causes for these changes remain unclear.

Rather than argue there is no need for anesthesia, the editorial was intended more to question what we are aiming to achieve with general anesthetics. In an adult, we clearly wish the patient to be unconscious and have no memory. This gives us a measure of effective anesthesia. Neonates have no explicit memory, and it is difficult to assess a clear point of unconsciousness. On a practical level, this makes it very hard to determine what dose we should give. To take the argument one step further, the editorial raised the question of whether or not they need to be unconscious at all. From a humane perspective, most would also argue it is appropriate to strive to prevent both their pain and distress, regardless of any evidence for or against a quantifiably better outcome. But does a neonate need to be rendered oblivious with the commonly used general anesthetics to prevent distress? Perhaps not; perhaps opioids or other sedatives are sufficient to prevent distress. However, giving enough general anesthetic is certainly one way to guarantee they are not distressed (although this is easier said than done as we don't know the dose needed).

Another aim of anesthesia is to attenuate the humeral and cardiovascular responses to surgery. Given their vulnerability, this aim may be of particular importance to neonates; but once again we have little idea which anesthetic technique is optimal for this. We share Dr. Lippmann's concerns about causing hypotension. In neonatal anesthesia the fundamental requirement to avoid cardiovascular instability and respiratory compromise is far more important than any concern over possible neurotoxicity from too much anesthesia, or that a neonate may perceive vague sensations from too little. In other words, we don't know if neurotoxicity or nondistress-