of gene-expression profiling to assess cancer prognosis and guide therapy; the use of genotyping to stratify patients according to the risk of a disease, such as prolonged QT interval syndrome or myocardial infarction; the use of genotyping to increase our understanding of drug pharmacokinetics and pharmocodynamics; and the use of genetics for tissue engineering and the cloning of several different species.[1–4] Recently, the National Human Genome Research Institute announced the formation of the International HapMap project, which will attempt to improve the ease and accuracy of human genetic risk profiling by creating a haplotype map consisting of approximately 500,000 tag single nucleotide polymorphisms from the more than 10 million that exist within the human genome. Even in diseases such as Huntington chorea, in which identification of the specific causative mutation has yet to lead to improved treatment, patients and their families have benefited from genetic counseling.[5] *All of these mind-boggling accomplishments have occurred within a single generation.*

Is perioperative functional genomics ready for prime time? Maybe not quite yet. But one thing is assured: If genetic advances continue to occur at the current rate and the discipline of anesthesiology remains on the sidelines, we may very well find ourselves in the scientific "reruns" instead of at the forefront of novel, cutting-edge research.

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Base Excess and Strong Ion Difference: Clinical Limitations Related to Inaccuracy

To the Editor:—The problem of method-related errors, arising from different measuring technologies on calculation of the anion gap and the strong ion difference, was clearly demonstrated in patients in a recent study by Morimatsu *et al.*[1] Mean values differed significantly, in some cases leading to a diverging assessment of the acid-base or electrolyte status. To a clinician, however, this is not acceptable.

All quantities, including the base excess (BE), used for diagnosis of nonrespiratory acid-base disturbances (*e.g.*, metabolic, renal, or intestinal) are calculated quantities. Hence, each quantity must be assessed for reliability and associated diagnostic interpretation (normal range and normal values: mean ± SD; pathologic range). This greatly depends on the inaccuracy and imprecision of each of the measured primary values used in the particular calculation and on how these are propagated. BE is usually obtained with arterial blood from measured pH, partial pressure of carbon dioxide (P_{CO_2}), and hemoglobin-concentration in a blood gas analyzer, the strong ion difference from measured plasma electrolyte concentrations (*e.g.*, Na, K, Cl, lactate).

For clinical practice, we propose the whole blood BE, which should be preferably used depending on the following considerations:

Inaccuracy of calculated BE: If correctly calculated, BE can be obtained from measured pH, P_{CO_2}, oxygen saturation, and total hemoglobin in any blood sample (venous or arterial). Over the whole range (−30 to +30 mmol/l), mean inaccuracy is less than 1 mmol/l.[2]

Normal values for BE and variability: Normal values for BE in arterialized capillary blood of men (n = 20) are −0.1 ± 1.2 mmol/l, and of women (n = 20), −1.0 ± 1.1 mmol/l.[3] Variability of BE in healthy individuals is very low and could be reproduced if calculated also from measurement in venous blood. Typical results (mean ± SD) as obtained with blood from the vena cubitalis (50 healthy volunteers: colleagues and medical students) are shown in Table 1. Values for pH, P_{CO_2}, partial pressure of oxygen, and oxygen saturation were measured in a blood gas analyzer (AVL OMNI 9; Roche Diagnostics, Mannheim, Germany), calibrated with two precision buffers for pH (Radiometer phosphate buffer S 1500; S 1510), and the mean calculated BE was −0.1 ± 1 mmol/l. It should be noted that the SD of BE is still low, even though measured values used in the calculation varied largely (Table 1).

Tolerable values of inaccuracy: Representative normal values and maximal inaccuracy of the measured acid-base and electrolyte variables in blood, as tolerated by the recommendations of the German Medical Association (Bundesärztekammer 2002, Köln, Germany) for the electrolyte concentrations in the plasma are Na 142 ± 2.8 mmol/l (2.0%); K 4.5 ± 0.2 mmol/l (3.7%); Cl 103 ± 4.1 mmol/l (4%); and lactate 1.5 ± 0.1 mmol/l (6%). Using these figures, the normal value of the strong ion difference (Na + K − Cl − lactate) is calculated as 42 ± 5.0 mmol/l, with high inaccuracy from propagation of errors. Hence, reliability is strongly reduced, dominated by the largest errors (Na: ± 2.8 mmol/l; Cl: ± 4.1 mmol/l).

Table 1. Normal Values for the Base Excess (BE) from Venous Blood (n = 50)

	Mean	±SD
pH	7.352	0.023
P_{CO_2}, mmHg	51.2	4.9
P_{O_2}, mmHg	28.6	10.2
S_{O_2}, %	49.2	22.0
BE, mmol/l*	−0.10	1.0

* BE is calculated from measured venous pH, P_{CO_2}, S_{O_2}, and total Hb.

P_{CO_2} = partial pressure of carbon dioxide; P_{O_2} = partial pressure of oxygen; S_{O_2} = oxygen saturation.

In comparison, normal BE is 0 ± 2.2 mmol/l when calculated from normal values of pH 7.40 ± 0.02, P_{CO_2} 40 ± 1.6 mmHg (4%), hemoglobin 15 ± 0.3 g/dl (2%), and full oxygen saturation ∼ 100%. Reliability of BE is mainly affected by the inaccuracy of measurement for pH and P_{CO_2}, whereas that for hemoglobin is negligible.

BE as a prognostic factor: The diagnostic use and prognostic value of BE is well documented. Among 10 clinical hemodynamic and 20 blood laboratory parameters tested, change in BE proved to be the best predictor of blood volume changes in a canine hemorrhagic shock model.[4] In critically ill patients BE has been established as an independent predictor of mortality[5] and endpoint of resuscitation. On the basis of 8,200 polytrauma patients, statistically selected out of 15,200 from four clinical studies, mortality increased significantly with a decrease in BE, *e.g.*, approximately by 25% if the assessed BE was −6 mmol/l within the first 24 h after admission (see figure 4 in reference 6).[6]

Conclusions: Because mortality may increase considerably (∼ 8%) when BE is decreased by only 2 mmol/l, the clinical requirements for

reliability (inaccuracy, imprecision) should be high (≤ 2 mmol/l). By using present standard measuring technology, this is met only for the BE and not for the strong ion difference or lactate alone. The latter should be used only as secondary parameters in combination with the BE for a differential diagnosis, *e.g.*, nonrespiratory acidosis correlated to lactate, hyperchloremia, or anion gap.[7]

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Alternative Formula for *Laryngeal Mask Airway*™ Size Selection

To the Editor:—Size selection of the *Laryngeal Mask Airway™* (*LMA™*; Laryngeal Mask Company Limited, San Diego, CA) is important for avoiding complications and is based on patient body weight.[1] The previously proposed formula for determining the appropriate *LMA™* size[2] is impractical because it contains the square root of the patient's body weight. We advocate here an alternative formula: *LMA™* size = 1 + BWru/20, where BWru indicates body weight (in kilograms) rounded up at the first digit. For example, if a patient's body weight of 14 kg (BWru) is 20 because 14 can be rounded up to 20 at the first digit, the calculation would be as follows: *LMA™* size = 1 + 20/20 = 1 + 1 = 2.

If the calculation of *LMA™* size shows 3.5 or 4.5, we choose *LMA™* #3 or #4. This manner of size selection agrees with the recommendation by Brimacombe and Brain.[1] Alternatively, if the calculated *LMA™* size is 3.5 or 4.5, we can also use *LMA™* #4 or #5. This size selection is similar to the sex-based *LMA™* size recommendation for adult patients.[3]

Our formula is convenient for pediatric patients, although it cannot be used in infants weighing less than 5 kg. In addition, the formula does not require a pocket calculator.

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Delayed Postoperative Arousal following Remifentanil-based Anesthesia in a Myasthenic Patient Undergoing Thymectomy

To the Editor:—Remifentanil (Ultiva; GlaxoSmithKline, Middlesex, UK) is an "ultra-short"–acting opioid that is rapidly hydrolyzed by circulating and tissue nonspecific esterases. Discontinuation of remifentanil infusion will be followed by a rapid recovery regardless of the duration of infusion.[1] The present report used the remifentanil-based technique of anesthesia, without the use of muscle relaxants, in a myasthenic gravis patient undergoing transternal thymectomy. However, the patient manifested unexpected delay of postoperative arousal for 12 h. This is the first case report about a significant delay of postoperative arousal following discontinuation of remifentanil infusion.

A 19-yr-old female patient (body weight, 57 kg) presented with myasthenia gravis (Osserman 2A) associated with a thymoma. Pyridostigmine, 60 mg, four times daily was administered for 2 months, to be followed by transternal thymectomy. The pyridostigmine regimen was maintained until the morning of surgery.

Premedication was limited to 0.2 mg intramuscular glycopyrrolate and1 mg intravenous midazolam. Anesthesia was induced with100 mg lidocaine and 2 mg/kg propofol intravenously, to be followed by 3.0 μg/kg remifentanil over 30 s, and tracheal intubation. Anesthesia was maintained by sevoflurane 1–2% in 100% oxygen, supplemented with remifentanil infusion (0.1–0.25 $\mu g \cdot kg^{-1} \cdot min^{-1}$). Neuromuscular transmission was monitored by electromyography using a Datex relaxograph (NMT-100–23–01; Datex-Ohmeda Division, Instrumentarium Corp, Helsinki, Finland), using the electromyographic response to ulnar nerve stimulation by the train-of-four. Intraoperatively, blood pressure ranged between 75/30 mmHg and 105/55 mmHg, heart rate ranged between 55 and 90 bpm, and electromyography showed normal T1/control and T4/T1 ratios. The duration of surgery was 2 h. Thirty minutes before the end of surgery, 5 mg intramuscular morphine was administered. Twenty minutes before the end of surgery, sevoflurane was turned off, and on completion of surgery remifentanil infusion was discontinued. The total dose of remifentanil administered throughout surgery amounted to about 2,000 μg.

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