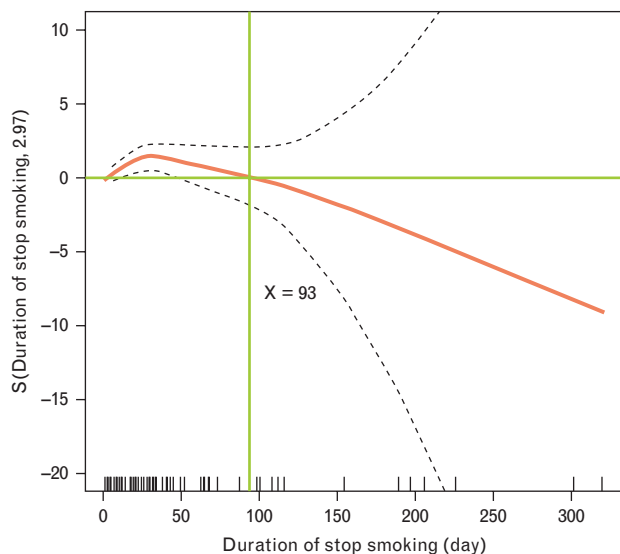**Fig. 1**

Generalised additive model plot for the effect of stop smoking duration on the risk of developing PPCs. The S in the S (duration of stop smoking) represented the risk of developing PPCs, where S of more than 0 indicates an increased risk and S of less than 0 indicates a decreased risk. The results showed that patients with a smoking cessation of more than 93 days may have a lower risk of PPCs. PPCs, postoperative pulmonary complications.

elective oesophagectomy, Yoshida *et al.*[7] found that a preoperative smoking cessation of more than 90 days was needed to reduce morbidities after surgery. In the present study, a general additive model was used to determine the relationship between the duration of smoking cessation and the risk of PPCs and we found that a minimum duration of 93 d was required, a result similar to that of Yoshida *et al.*[7] Two meta-analyses also show that a longer duration of smoking cessation is associated with a lower risk of PPCs.[4,6] These findings suggest that a short period of smoking cessation (median 4 weeks before surgery) does not restore a normal respiratory system.

The study has several limitations. First, as a secondary analysis, the fixed patient population has the potential to produce bias. Second, the data on preoperative smoking were collected according to reports of patients themselves, raising the possibility of recall bias. Third, the sample size in this study was not designed for detecting the association between smoking status and the risk of PPCs. For example, only 49 patients had a smoking cessation of 93 days or less; and among them, only 13 patients developed PPCs. This lowered the power of the analyses and so results here may only be considered to be exploratory.

In conclusion, for elderly patients with a smoking history scheduled to undergo noncardiac, nonneurological surgery, a preoperative smoking history, a high smoking index (>8 pack-years) or a short duration smoking cessation (≤93 days) was associated with an increased risk of PPCs. A

smoking cessation of more than 93 days may be helpful to reduce PPCs, but requires further study.

References

1 Canet J, Gallart L, Gomar C, *et al.* Prediction of postoperative pulmonary complications in a population-based surgical cohort. *Anesthesiology* 2010; **113**:1338–1350.
2 Molena D, Mungo B, Stem M, *et al.* Incidence and risk factors for respiratory complications in patients undergoing esophagectomy for malignancy: a NSQIP analysis. *Semin Thorac Cardiovasc Surg* 2014; **26**:287–294.
3 Theadom A, Cropley M. Effects of preoperative smoking cessation on the incidence and risk of intraoperative and postoperative complications in adult smokers: a systematic review. *Tob Control* 2006; **15**:352–358.
4 Wong J, Lam DP, Abrishami A, *et al.* Short-term preoperative smoking cessation and postoperative complications: a systematic review and meta-analysis. *Can J Anaesth* 2012; **59**:268–279.
5 Mills E, Eyawo O, Lockhart I, *et al.* Smoking cessation reduces postoperative complications: a systematic review and meta-analysis. *Am J Med* 2011; **124**:144.e8–154.e8.
6 Zaman M, Bilal H, Mahmood S, *et al.* Does getting smokers to stop smoking before lung resections reduce their risk? *Interact Cardiovasc Thorac Surg* 2012; **14**:320–323.
7 Yoshida N, Baba Y, Shigaki H, *et al.* Duration of smoking cessation and postoperative morbidity after esophagectomy for esophageal cancer: how long should patients stop smoking before surgery? *World J Surg* 2016; **40**:142–147.

Capillary glucose meters cannot substitute serum glucose measurement to determine the cerebrospinal fluid to blood glucose ratio

A prospective observational study

Romain Asmolov*, Geoffroy Rousseau*, Leslie Grammatico-Guillon and Antoine Guillon

From the Faculté de Médecine, Université François Rabelais (RA, GR, LG-G, AG), Département d'Anesthésie et Réanimation, CHRU Tours (RA), Département de Médecine d'Urgence, CHRU Tours (GR), Service d'Information Médicale, Epidémiologie et Economie de la Santé, CHRU Tours (LG-G), and Service de Médecine Intensive - Réanimation, CHRU Tours, France (AG)

Correspondence to Antoine Guillon, Service de Médecine Intensive - Réanimation, CHRU Tours, 2 Bd Tonnellé, F-37044 Tours Cedex 9, France
Tel: +33 247471322; fax: +33 247396536;
e-mail: antoine.guillon@univ-tours.fr
*Romain Asmolov and Geoffroy Rousseau contributed equally to the article.

Editor,

Bacterial meningitis is a life-threatening infectious disease requiring prompt recognition and treatment.[1]

The gold standard for diagnosing meningitis is examination of the cerebrospinal fluid (CSF). However, no CSF parameter provides an absolute indication of cause (for example, an elevated white blood cell count and high protein levels are nonspecific features of the CSF after neurosurgery). A low CSF glucose concentration is an important finding for the investigation: a CSF/serum glucose ratio cut-off of 0.36 is both highly sensitive and specific (both 93%) for diagnosing bacterial meningitis.[2] The CSF glucose concentration is influenced by the serum concentration and, therefore, cannot be independently interpreted without the CSF/serum glucose ratio. Nevertheless, recent guidelines have emphasised that serum glucose measurements are often not performed in clinical practice, leading to suboptimal analysis of CSF glucose levels.[3,4] We previously conducted an internal quality assessment in our institution and confirmed that serum glucose simultaneously measured with CSF glucose is performed in only one-third of CSF examinations. This has been addressed in the clinic by measuring the capillary glucose value using a bedside glucometer, at the time of the lumbar puncture, to calculate the CSF/capillary glucose ratio. However, this practice has not been tested nor validated. We aimed to evaluate whether the CSF/capillary glucose ratio is equivalent to the CSF/serum glucose ratio.

We performed a prospective study and analysed CSF samples in patients hospitalised in two ICUs during an 8-month period. Venous and capillary blood samples were taken within one hour before/after CSF sampling. Glucose (CSF and serum) was measured by the central laboratory, whereas capillary glucose was measured by a point-of-care glucometer (FreeStyleOptium; Abbott, Doncaster, Victoria, Australia). The results are presented according to the Bland–Altman method. We calculated the bias between paired glucose ratios (CSF/capillary glucose–CSF/serum glucose), the limits of agreement. We assessed if the bias was influenced by the range of measurements by performing the linear regression of the difference versus average and calculating the coefficient of determination (R^2) from the Pearson correlation coefficient. We calculated the mean percentage error to evaluate if the magnitude of errors between the two techniques had clinical importance. The mean percentage error was derived by dividing the confidence interval (CI) obtained by the Bland–Altman method (difference between the lower and upper limits of agreement) by the overall mean value of the CSF/serum glucose ratio obtained with the central laboratory. Ethical approval for this study (Ethical Committee No. 2015-042) was provided by the Ethical Committee ERERC of Centre Val de Loire, Tours, France (Chairperson Dr B. Birmele) on 16 October 2015. All patients included in this study were personally informed by a written document about the treatment of the data, as well as their right to object to the study and obtain access to the data, according to

Fig. 1
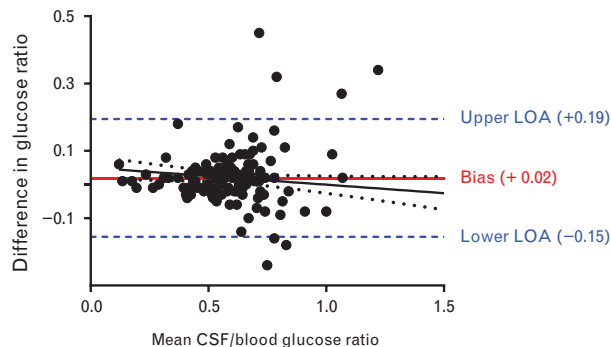
Bland–Altman plots for the comparison of cerebrospinal fluid/blood glucose ratios with blood capillary glucose assessed by bedside glucometer or serum glucose by the central laboratory. The solid red line indicates the mean difference (bias) between the methods (cerebrospinal fluid/capillary bedside glucose–cerebrospinal fluid/serum glucose); the broken blue lines indicate the limits of agreement. The solid and dash black lines represent the regression line of difference versus average and its 95% confidence interval ($y = -0.05x + 0.05$, $R^2 = 0.03$ with $P = 0.06$).

articles L.1121-1 and R1121-2 of the French Public Health Code, and gave their consent.

We analysed 129 CSF samples [50 (39%) obtained by lumbar puncture, 79 (61%) obtained by ventricular external drain] in 86 patients. The median age was 62 (interquartile range 52 to 72) years; men represented 56% of the patients. Bacterial meningitis was diagnosed in 13 cases (the diagnosis of bacterial meningitis was determined by two expert physicians after reviewing the entire medical chart, including the history of the clinical presentation, CSF features and CSF microbial diagnosis). Bland and Altman plots showed that the bias was 0.02, with lower and upper limits of agreement of −0.15 and 0.19 (Fig. 1). Thus, 95% of the differences from the bias between two diagnostic-methods are expected to be within a CI equal to 0.34. The mean glucose ratio was 0.6 with the gold standard methods; indeed, the percentage error was 57%. The clinical question is one of substitution: whether it is possible to measure the glucose ratio with either capillary bedside glucose or serum glucose and obtain the same results. We conclude that the variability of the method is unacceptable, and, thus, the two methods are not interchangeable.

Finally, although timely blood glucose measurement is often lacking during CSF sampling, capillary bedside glucose measurements may not be used as a surrogate of serum glucose assessment to measure the CSF/blood glucose ratio.

Acknowledgements relating to this article

EJA

References

1 Koster-Rasmussen R, Korshin A, Meyer CN. Antibiotic treatment delay and outcome in acute bacterial meningitis. *J Infect* 2008; **57**:449–454.

2 Tamune H, Takeya H, Suzuki W, *et al.* Cerebrospinal fluid/blood glucose ratio as an indicator for bacterial meningitis. *Am J Emerg Med* 2014; **32**:263–266.

3 McGill F, Heyderman RS, Michael BD, *et al.* The UK joint specialist societies guideline on the diagnosis and management of acute meningitis and meningococcal sepsis in immunocompetent adults. *J Infect* 2016; **72**:405–438.

4 Nigrovic LE, Kuppermann N, Macias CG, *et al.* Clinical prediction rule for identifying children with cerebrospinal fluid pleocytosis at very low risk of bacterial meningitis. *JAMA* 2007; **297**:52–60.