will decrease further below the threshold and result in unpleasant symptoms.

Data from Langesæter et al.1 suggest that liberal administration of phenylephrine to achieve tight blood pressure control may result in lower cardiac output than a less aggressive approach. However, the clinical relevance of this in healthy elective patients is undetermined. Dyer and James2 stated that heart rate and blood pressure are used clinically as surrogate markers of maternal cardiac output, and that maximum changes in the latter correlate better with uteroplacental blood flow than with upper arm blood pressure. However, it has yet to be proven whether a global measure of cardiac output is the ideal parameter on which to base hemodynamic therapy in obstetric patients, since this does not necessarily represent regional flow in the uterus and placenta, which have widely dilated vasculature through which flow is largely pressure-dependent.8 Furthermore, studies in animals that have correlated fetal oxygen uptake with uterine blood flow have demonstrated that, under normal physiologic conditions, uterine blood flow is in excess of the minimum required to satisfy fetal oxygen demand.9 This confers a margin of safety that, to a degree, protects the fetus from fluctuations in uterine blood flow.10 If the same situation occurs in humans it could explain the lack of fetal acidosis observed when large doses of phenylephrine are used to maintain maternal blood pressure.3–5 Despite evidence that this drug has the potential to decrease both cardiac output and uteroplacental blood flow. The implication of this is that in healthy parturients, within limits, even if hemodynamic control using phenylephrine does slightly reduce cardiac output and uteroplacental blood flow, it may still be clinically acceptable if this is balanced against other benefits such as maternal wellbeing.

Langesæter et al.1 concluded that that low-dose bupivacaine (with sufentanil), combined with a low-dose infusion of phenylephrine and moderate cohydration, gives the “best” hemodynamic stability. However, they can only validly make comparisons among the actual regimens included in their study. Because there were no direct comparisons with patients who received higher doses of phenylephrine or larger volumes of cohydration, it is speculative to assume that any of their regimens were superior to these other possible regimens. Moreover, a large proportion of their patients who received a low-dose phenylephrine infusion required supplementary boluses of vasopressors. Thus the mean phenylephrine requirement per patient was somewhat greater than the baseline 0.25 µg · kg⁻¹ · min⁻¹ and it cannot be excluded that a higher infusion rate may have provided more stable hemodynamic control. Also, when assessing the optimal regimen for hemodynamic control, we believe that ease of use is also a factor to be considered. In that respect, we consider a vasopressor infusion that is titrated to a defined endpoint to be superior to the use of a hybrid technique of a fixed rate low-dose infusion to which is added repeated “rescue” boluses for times when the infusion is inadequate. This is especially relevant during single-shot spinal anesthesia when small intrathecal doses as used by Langesæter et al.1 may not be appropriate.

We continue to advocate aggressive maintenance of blood pressure using phenylephrine in women having elective cesarean delivery under spinal anesthesia. Although it may be possible that cardiac output is slightly less with this method compared with allowing blood pressure to drift 10 to 20% below baseline, unless evidence is produced that this is associated with a clinically important decrease in uteroplacental blood flow and with a detrimental effect on neonatal outcome, we believe that improved maternal comfort justifies our technique.


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Maternal Hemodynamic Monitoring and the Vigileo Monitor

To the Editor.—We read the recent editorial by Dyer and James,1 referencing the paper by Langesæter et al.2 with great interest. Langesæter et al.2 have successfully demonstrated that a minimally invasive technology that measures cardiac output (LiDCOplus, LiDCO Ltd., Cambridge, United Kingdom) can be used for maternal hemodynamic monitoring. Other arterial pressure waveform–based systems that provide beat-by-beat assessment of cardiac output and stroke volume include the PICCOplus (Pulsion Medical Systems, Munich, Germany) and the Vigileo monitor/FloTrac sensor (Edwards Lifesciences LLC, Irvine, CA). Dyer and James3 note in their editorial that these less invasive methods of hemodynamic monitoring are attractive to the obstetric anesthesiologist. However, the editorial4 view that the Vigileo monitor is unsuitable for the study of rapid maternal hemodynamic changes is not a logical conclusion.

Bland-Altman analysis is routinely used to assess precision and bias when comparing two different measurement techniques.5–9 As acknowledged in the editorial, the acceptance of a new technique of cardiac output measurement should rely on limits of agreement of up to ± 30% between the minimally invasive techniques and the existing “gold-standard” (i.e., the thermodilution pulmonary artery catheter). There are currently several studies in the critical care and cardiac anesthesia literature that have evaluated precision and bias (using Bland-Altman analyses) in the measurements of cardiac output with the Vigileo monitor/FloTrac sensor.5,7,8 Based on these studies, statisti-
critically ill population. 3,10 Fluid and pharmacologic therapy algo-

We will now examine the specific situation of the measurement of cardiac output after the administration of phenylephrine during card-
diary surgery (based on which the editorial concludes that the Vigileo monitor ‘may not be suitable’).9 The basic physiologic principle un-
derpinning the Vigileo device is that left ventricular stroke volume and

Vigileo cardiac output readings will underestimate thermodilution

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