TO THE EDITORS: We read with great interest the recent analysis of the uterine electromyogram, most commonly referred to as electrohysterogram (EHG), that was proposed by Lucovnik et al.\textsuperscript{1}

We have previously advanced the hypothesis that the analysis of the propagation velocity (PV) in combination with other parameters that are derived by the EHG has potential value for discriminating between productive and unproductive uterine contractions.\textsuperscript{2,3} We believe that the impact of this study, which is the first to test this hypothesis on a broad population, is such that it deserves a thorough discussion on some fundamental methodologic aspects, which were not fully tackled in the article.

At a first glance, values and variability of PV that are found in the labor groups are surprisingly up to 10 times higher than those previously reported.\textsuperscript{3,4} Unfortunately, the authors did not comment on this.

We believe that the most plausible explanation to this discrepancy resides in the combination of the recording methods with the nature of uterine contractions. The article suggests that the PV was estimated by the analysis of 2 differential electrode couples; however, their relative position was not specified. The nature of uterine contractions is such that origin and direction of propagation of the EHG are a priori unknown.\textsuperscript{4} Therefore, EHG analysis poses demanding requirements for the number and relative position of the recording channels that are used for deriving the actual value of PV (ie, the value of velocity along the propagation direction). In general, the use of 2 recording channels may lead to PV values that do not correspond to the actual values.

Some possible EHG propagation patterns are represented schematically in the Figure. With reference to these examples, the approach of Lucovnik et al.\textsuperscript{1} leads to the actual value of PV only for example 1. For the other cases (highly expected in EHG recording), we would erroneously estimate PV values even 10 times higher than the actual ones.

To conclude, the significantly higher values of PV\textsuperscript{1} relative to previous studies may be ascribed to the use of only 2 recording channels. As a consequence, without questioning the potential clinical value of the study, we are tempted to speculate that the significant differences of PV between the labor and nonlabor groups that were reported may be the result of a different propagation path, rather than a higher velocity. Some further insights could be gained, for example, by the use of a multichannel electrode grid.\textsuperscript{3}

Chiara Rabotti, PhD
Eindhoven University of Technology,
Department of Electrical Engineering
Signal Processing Systems group
PO Box 513, 5600MB
Eindhoven, The Netherlands
c.rabotti@tue.nl

S. Guid Oei, PhD
Eindhoven University of Technology,
Department of Electrical Engineering
Signal Processing Systems group
PO Box 513, 5600MB
Eindhoven, The Netherlands

correspond to the actual values.

FIGURE

Examples of possible EHG propagation patterns as recorded by 2 channels

The origin of the EHG signal is indicated by a star, the propagation path with wave front by arrows and the 2 bipolar channels by dots.

\textit{EHG}, electrohysterogram.
PO Box 7777, 5500MB
Veldhoven, The Netherlands
Janneke van ’t Hooft, MD
Máxima Medical Center
Department of Obstetrics and Gynecology
PO Box 7777, 5500MB
Veldhoven, The Netherlands
Massimo Mischi, PhD
Eindhoven University of Technology,
Department of Electrical Engineering
Signal Processing Systems group
PO Box 513, 5600MB
Eindhoven, The Netherlands

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REPLY

We thank Dr Rabotti et al for their letter regarding our publication in the March 2011 issue of the Journal. It gives us the opportunity to discuss the methods used in our study in more detail. We already mentioned all of the electrode setups and inherent limitations in our original submission, but, unfortunately, we were asked to reduce the article size by the Editors. Nevertheless, we did describe the setup that we used with its advantages and disadvantages in our recently published review article.1

Propagation velocity (PV) of electrical events in the myometrium is a rather old concept that goes back to the 1940s.2 Our group has measured cell-to-cell conduction in many studies after we noted that gap junctions, which are low-resistance contacts for current spread, exist between myometrial cells during term and preterm labor.3 PV has been studied by many, and there is a wide range of values that depend on the species and the equipment that are used. As Rabotti et al noted, the velocities that were reported in our article are higher than many of the values that were published earlier. For our instrument, we use differential, bipolar electrode pairs. Because of this, we had to assess the propagation by finding time differences of signal arrivals at adjacent electrode pairs, rather than at individual electrodes. The advantage of a bipolar setup over a monopolar setup is better signal quality, which allows us to identify individual uterine voltage peaks more accurately. The disadvantage of such a setup, however, is that purely vertical propagation produces a minimal measurement because of the common mode rejection of the amplifiers; however, purely horizontal waves are registered, and these “horizontally moving” waves impinge at adjacent upper and lower pairs in rapid succession. This results in an underestimation of the signal time of arrival interval between electrodes and produces a PV overestimation. The reported velocity therefore is really a velocity analogue. This was both anticipated and mentioned already in our original article, and we also provided diagrams on how this occurs. Again, we were forced to eliminate the detailed explanations because of article size constraints.

None of this, however, affects the predictive values that were reported in our publication. The PV overestimation occurs for both laboring and nonlaboring patients alike because it is a systematic error, and, using this arrangement, we still see significant differences in the signal time of arrival interval between patients in true labor and false labor. Because the PV is proportional to this time interval, the velocity estimation, mathematically speaking, is also significantly different.

Future studies may use different electrode and amplifier configurations to determine more accurately the uterine electrical signal PV value. We have to stress, however, that, although this may be an important basic science question, it will not change the clinical implications as published in our article.

Miha Lucovnik, MD
William L. Maner, BSc, BA
Robert E. Garfield, PhD
St. Joseph’s Hospital and Medical Center
Downtown Campus at TGen
445 N 5th St.
Phoenix, AZ 85004
robert.garfield@chw.edu

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