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Original Research

Ultrasound by midwives in the postpartum period: feasibility, reproducibility and midwives' perspectives

S. Coremans[1], J. Muys[1], J. De Winter[1], H. De Raedemaecker[1], Y. Jacquemyn[1,*]

[1] *Department of Obstetrics and Gynaecology, Antwerp University Hospital UZA and Antwerp University UA, ASTARC and Global Health, Edegem (Belgium)*

Summary

Objective: To describe feasibility, reproducibility, and acceptability of introducing ultrasound by midwives as a routine in postpartum care. *Materials and Methods:* A quantitative, monocentric cross-sectional study used questionnaires to evaluate the viewpoint of the midwife and the mother; repeat transabdominal ultrasound measurements were made of uterine length, width, height, and endometrial thickness by midwives, junior gynaecology trainees, and experienced gynaecologic ultrasonographers, 24 to 48 hours after delivery; Bland-Altman plotting assessed interand intra-observer variability. *Results:* Fifty-five percent of midwives considered implementation of ultrasound in postpartum care as feasible; time restrictions were seen as an obstacle by 60%, and 97% considered themselves after training as capable to perform postpartum ultrasound autonomously. Almost all mothers valued the ultrasound as non-disturbing and interesting. Inter-observer variability demonstrated a fixed bias between midwives and gynaecologists for total uterine length but not for other measurements. Intra-observer variability decreased with experience but was generally low and there was no fixed bias. *Conclusion:* Midwives saw postpartum ultrasound as feasible in daily practice, reproducibility was acceptable, and the mothers' experience was positive. More study is needed to evaluate the eventual clinical value of routine postpartum ultrasound.

Key words: Postpartum; Retained products of conception; Ultrasound; Midwifery.

Introduction

Retained products of conception (RPOC) complicate around 1% of all deliveries [1] and are defined as remnants of placental trophoblastic origin [2]. If undiagnosed and not treated properly, they can result in secondary postpartum haemorrhage, infection, and intrauterine adhesions. Therefore, it is clinically important to recognise RPOC. Diagnosis is based on both clinical and ultrasonographic signs. Ultrasound is the only non-invasive method available in the maternity ward to visualise the uterine cavity and its methodology and value have been reviewed recently [3].

In traditional clinical practice, postpartum uterine evaluation is largely done by palpation of the uterus and looking for so-called 'sub involution', for which no clear and agreed definition exists. Evaluation of postpartum uterine changes by ultrasound would be more objective; when used as a routine, this should be an easy method, not requiring complex technology such as colour Doppler mapping and flow velocity measurements. In this study the authors evaluated the feasibility of midwives performing basic postpartum ultrasound in routine care and described the experiences of both midwives and mothers; furthermore we wanted to evaluate the interand intra-observer variability of transabdominal ultrasound assessment of the postpartum uterus.

Materials and Methods

The authors performed a quantitative monocentric cross-sectional study between February and May 2017 at the maternity ward of the Antwerp University Hospital UZA. The study was approved by the local ethics committee under the Belgian number B300201731030.

To evaluate the viewpoint of the midwife all midwives working at the maternity ward received a questionnaire with eight statements on postpartum ultrasound before any training was provided:

-Postpartum ultrasound is NOT to be performed only by medical doctors

-I expect results of measurements will NOT be significantly different between midwives and doctors

-I expect to have enough time to perform postpartum ultrasound in every mother

-I think postpartum ultrasound will be useful to detect retained products of conception

-I expect to be capable after training to perform postpartum ultrasound by myself

-I believe gynaecologists consider it to be part of my job to perform postpartum ultrasound

-I consider it useful to know in every postpartum woman whether retained products of conception have been found on ultrasound

-I think that when well organised a systematic ultrasound screening in the postpartum period by the midwife is feasible

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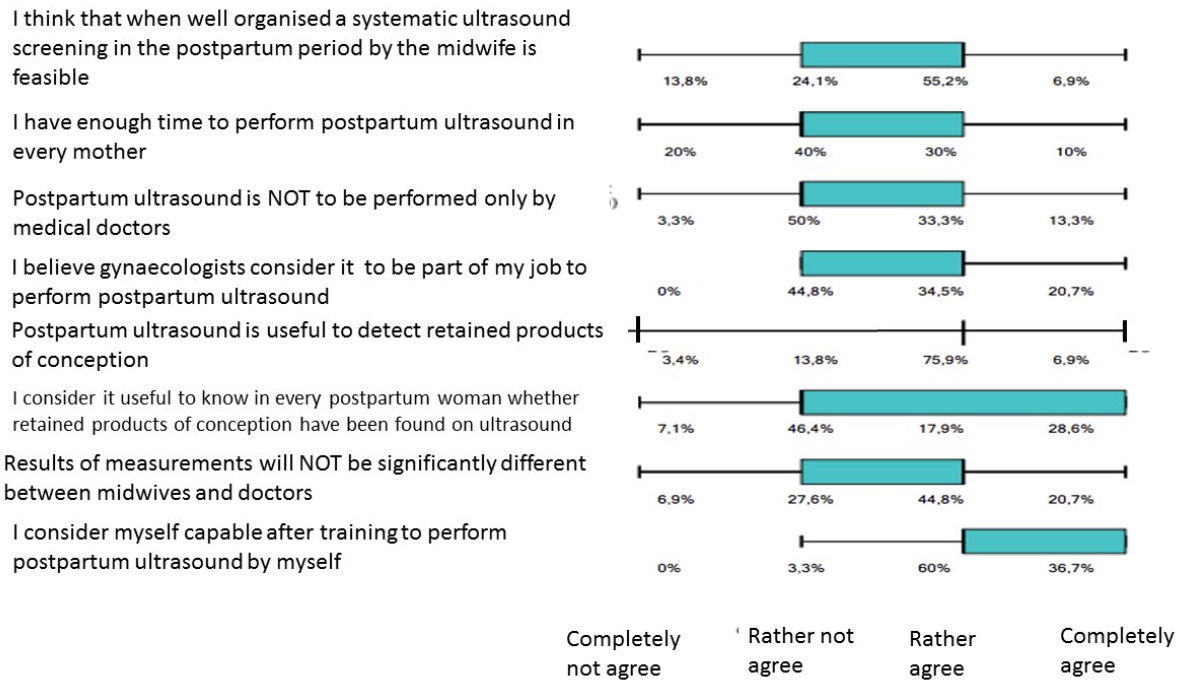
Table 1. — *Midwives' responses regarding postpartum ultrasound, with variance and relative frequency (N = 30)*



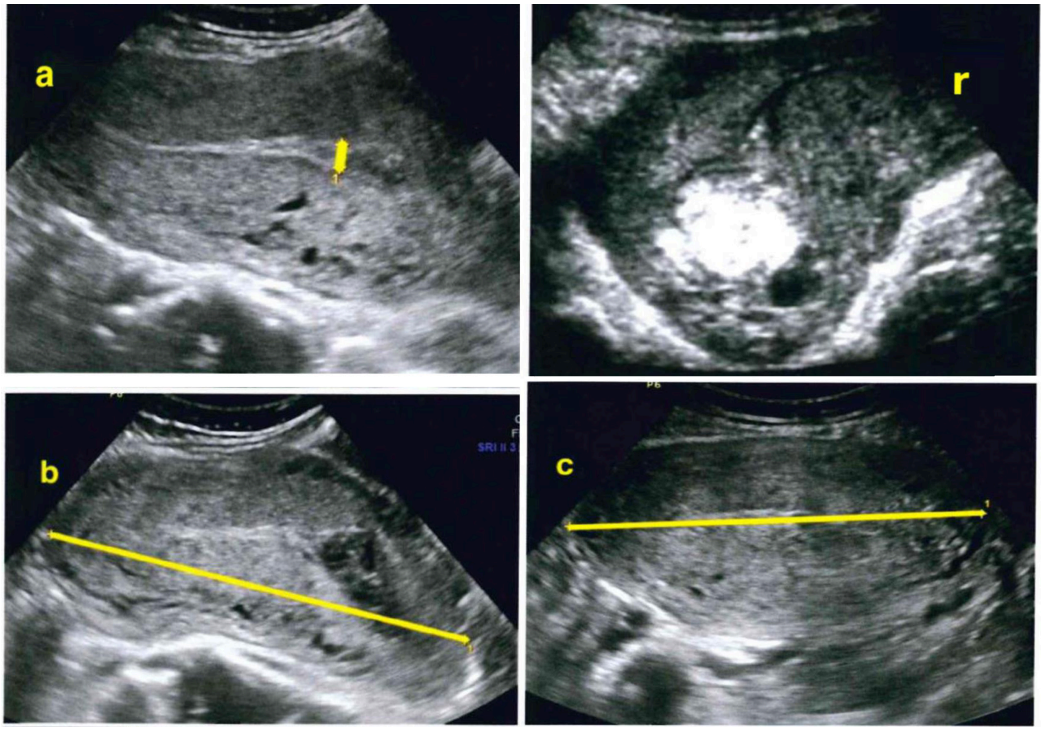
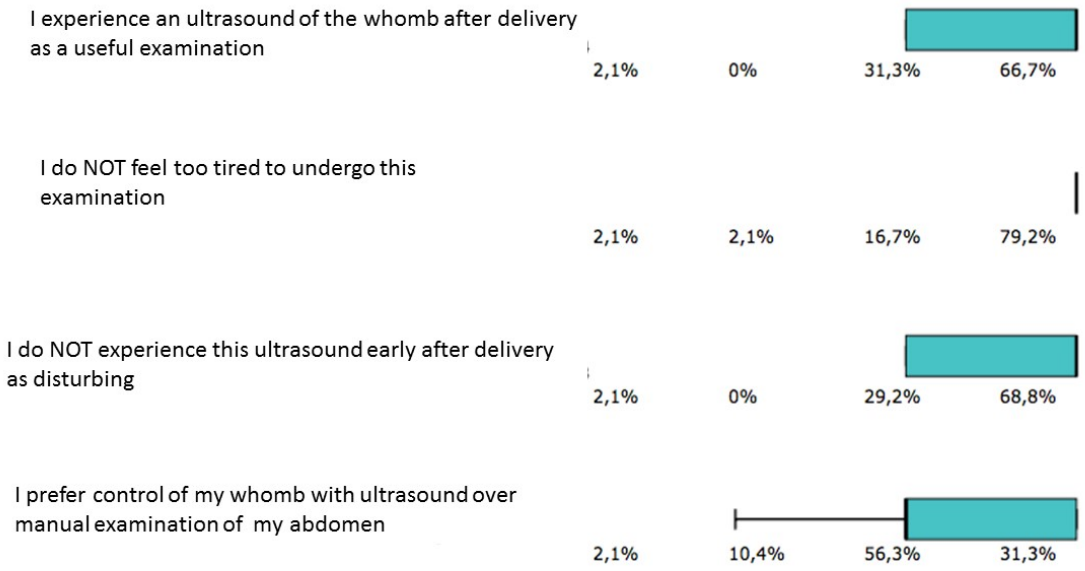


Figure 1. — Standardized images and measurements as performed on day 2 after delivery by transabdominal ultrasound. a) Measurement of the maximal endometrial thickness. b) Measurement of uterine length. c) Measurement of uterine width. r) Example of retained products of conception.

For every question a 4-tier response was available (completely do not agree; rather not agree; rather agree; completely agree) to produce a 4-point Likert score.

To evaluate the experiences of postpartum women, four questions were asked to 56 women that underwent postpartum ultrasound performed by a midwife:

Table 2. — *Opinions of recently delivered women, with variation and frequency (N = 56)*



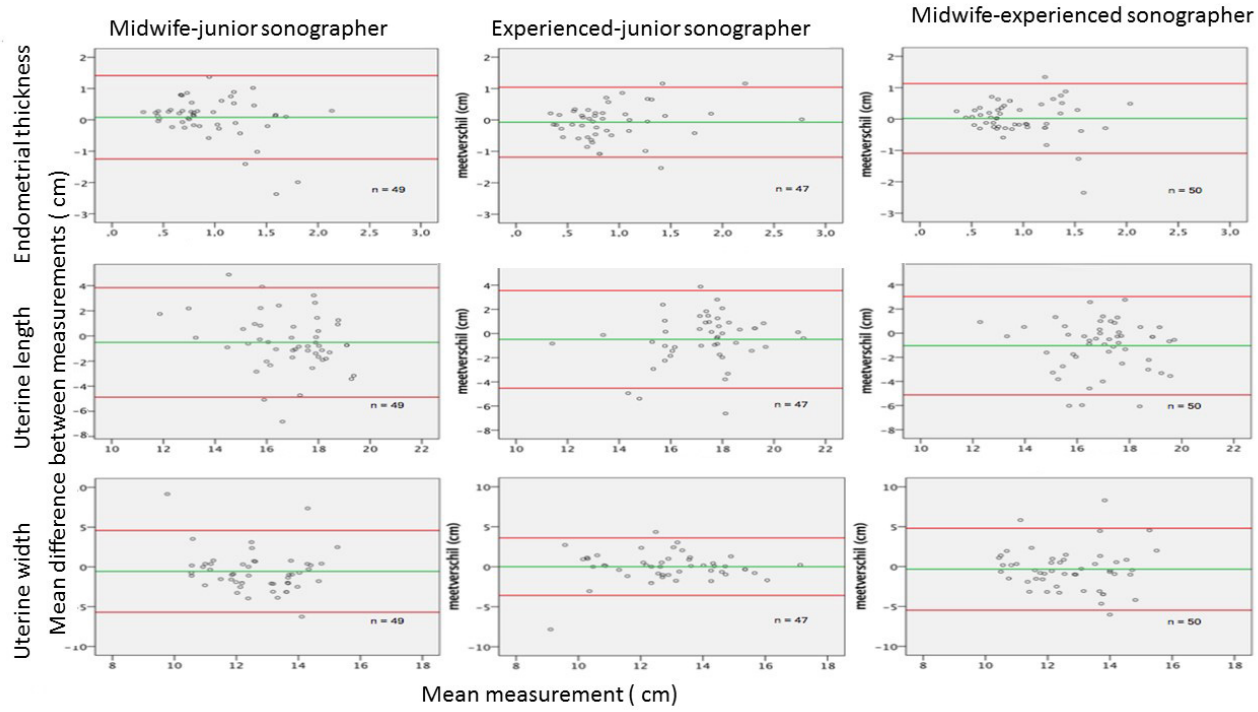
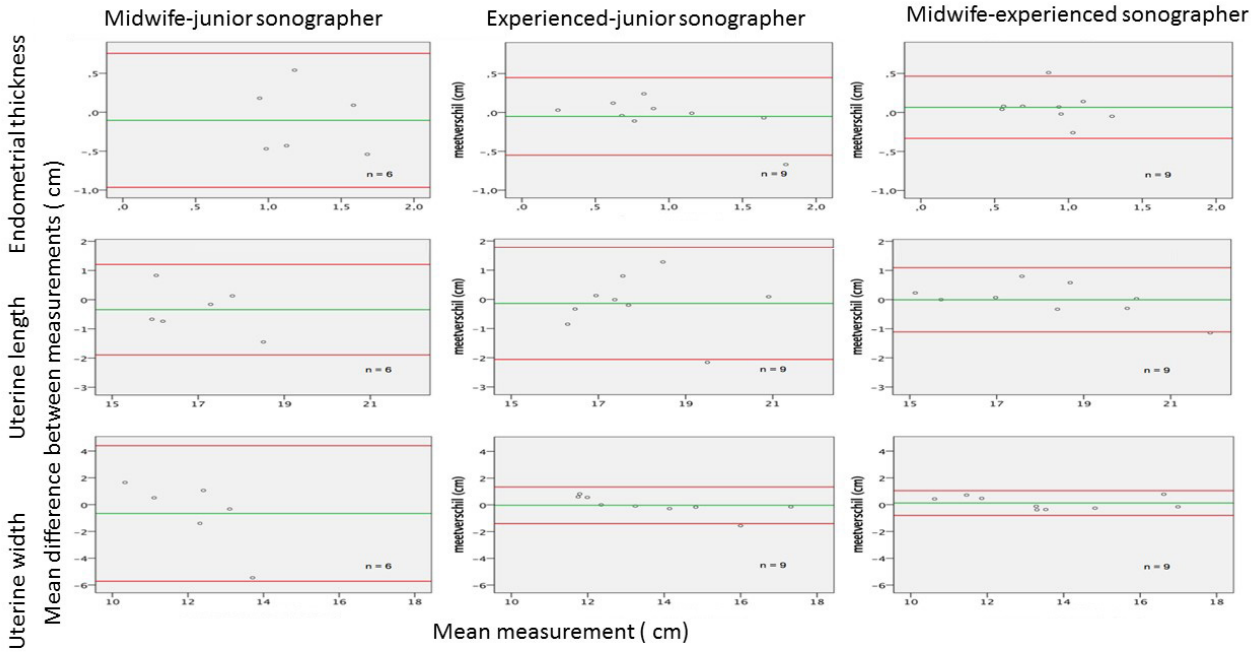


Figure 2. — Bland-Altman plot for inter-observer variability; three different measured dimensions (endometrial thickness, uterine length, and uterine width) are presented in rows and in columns with comparisons between different operators (midwife versus junior sonographer, junior sonographer versus experienced sonographer, and midwife versus experienced sonographer). The green line represents the mean difference between measurements and the red lines represent 95% confidence interval for the difference between measurements, i.e. limits of agreement.

Table 3. — *Inter-observerariability and testing for fixed and proportional biases*

		Midwife versus junior sonographer	Junior versus experienced sonographer	Midwife versus experienced sonographer
Endometrial thickness	A	0.08	-0.07	0.02
	B	0.4	0.38	0.81
	C	2.66	2.23	2.22
	D	0.02	0.16	0.36
Uterine length	A	-0.51	-0.48	-1.04
	B	0.11	0.11	0.001
	C	8.72	8.09	8.15
	D	0.06	0.21	0.73
Uterine width	A	-0.56	0.01	-0.34
	B	0.14	0.98	0.37
	C	10.28	7.19	10.27
	D	0.17	0.72	0.76

A: mean difference in measurement (cm). B: *p*-value for the hypothesis mean difference in measurement is 0 (fixed bias). C: limits of agreement interval (cm). D: *p*-value for hypothesis coefficient of the mean measurement is 0 (proportional bias).



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-I experience an ultrasound of the womb after delivery as a useful examination

-I do NOT feel too tired to undergo this examination

-I do NOT experience this ultrasound early after delivery as disturbing

-I prefer assessment of my womb with ultrasound over manual examination of my abdomen

Four responses were available: Completely do not agree; rather not agree; rather agree; completely agree.

Written informed consent was obtained from all midwives and mothers.

To determine interand intraobserver variability, five vol-

Table 4. — *Intra-observerariability and testing for fixed and proportional bias*

		Midwife versus junior sonographer	Junior versus experienced sonographer	Midwife versus experienced sonographer
Endometrial thickness	A	-0.11	-0.05	0.07
	B	0.58	0.56	0.36
	C	1.72	1	0.8
	D	0.74	0.05	0.56
Uterine length	A	-0.34	-0.14	-0.01
	B	0.34	0.68	0.97
	C	3.1	3.84	2.21
	D	0.43	0.84	0.1
Uterine width	A	-0.66	-0.03	0.12
	B	0.56	0.9	0.45
	C	10.13	2.74	1.85
	D	0.08	0.03	0.54

A: mean difference in measurement (cm). B: *p*-value for the hypothesis mean difference in measurement is 0 (fixed bias). C: limits of agreement interval (cm). D: *p*-value for hypothesis coefficient of the mean measurement is 0 (proportional bias).

unteer midwives who had no ultrasound experience whatsoever (in Belgium midwives do not perform routine ultrasound) received a twohour practical training consisting of a slide set and a life demonstration; finally each performed three measurements under supervision. How measurements were performed and the setup of the ultrasound machine was clearly defined (C5 abdominal convex probe, setup Gynecology, 18Hz, 20.1 cm depth). Measurements and descriptions were performed as described by Sokol *et al.* [4] and reviewed by De Winter *et al*. [3]. In every patient three measurements were performed: in a sagittal section, maximal thickness of the echogenic endometrial line and uterine length from the cervix to the top of the fundus; in a transverse view, uterine width from one side to the other was measured (Figure 1). The presence of hyperechogenic areas suggesting retained products of conception were noted as proposed by Sokol *et al.* [4]. If retained products were suspected to be present, the treating physician was warned for clinical follow-up.

The women recruited included those with term (37 to 41 weeks gestational age) births (vaginally or by cesarean section) but without gestational complications (diabetes, preeclampsia, preterm birth, etc). Further selection was purely based on practical considerations: not during weekends, and only on days that an experienced sonographer, a trained midwife, and a junior sonographer could attend. Postpartum ultrasound was performed at the bedside between 24 and 48 hours after delivery and after the woman gave written informed consent; all measurements were done three times by each examiner, who had no access to the results of the other ultrasonographers. For every patient these three measurements were done by three persons, namely a junior trainee in gynaecology, a midwife, and an experienced gynaecologist, resulting in nine measurements for uterine length, nine measurements for endometrial thickness, and nine measurements for uterine width.

Statistical analysis was performed with SPSS 24. To analyse interand intra-observer variability, Bland-Altman plots were constructed and compared; three measurements by three operators resulted in nine scatterplots for both interand intra-observer variabilities. A one sample *t*-test was performed on each variable for the difference in measurement using the mean difference and standard deviation of the difference; the 95% confidence interval for each difference in measurement was calculated. Furthermore, variability between measurements was evaluated using fixed and proportional biases.

Fixed bias was tested using the hypothesis that the mean difference was 0, for this a one sample *t*-test on the differences in measurement was used, a non-significant *p*-value ($p > 0.05$) indicated that there was no fixed bias between measurements. To exclude proportional bias, i.e. the value of the measurement could lead to variation in the difference in measurement, a linear regression analysis was performed with the mean measurement value as independent variable and the difference in measurement as dependent valuable. A *t*-test of the regression tested the hypothesis that the coefficient for the mean measurement result equals 0. In this case accepting the hypothesis ($p > 0.05$) confirmed that the mean value of the measurement had no statistically significant influence on the difference in measurement and excludes proportional bias.

To evaluate the perspectives of the midwives, there were a total of 30 midwives that responded, representing 91% (30/33) of all midwives working in the unit. All midwives were female, mean age was 43 ± 12.7 years, mean working experience as a midwife was 20.1 ± 12.6 years. Table 1 denotes their answers and shows that 55.2% of midwives considered implementation of postpartum ultrasound feasible, but 60% considered that there would not be sufficient time

available to perform this in every patient. Slightly more than half of the midwives were of the opinion that postpartum ultrasound should be performed by medical doctors; 44.8% stated that gynaecologists would consider postpartum ultrasound as part of the job of a midwife. The majority of midwives (65.5%) believed that their measurement results would be similar to those of the medical doctor and almost all midwives (96.7%), considered themselves able to perform postpartum ultrasound after training. Approximately 75% of midwives considered postpartum ultrasound as a potentially useful method in the detection of retained products of conception, but 52.5% stated that it was not useful to know in every recently delivered woman whether or not retained products of conception are present on ultrasound.

Fifty-six recently delivered women were recruited, mean age 30.2 $\pm$ 4.2 years, mean gestational age 38.7 $\pm$ 2.3 weeks, 11 (20%) caesarean sections, 47 (85.5%) were breastfeeding, 23 (41.1%) had given birth for the first time, 25 (44.6%) for the second, 6 (10.7%) for the third, and 2 (3.6%) for the fourth time. Their responses are summarized in Table 2. In general, postpartum ultrasound was positively evaluated by recently delivered women; 97.9% found that this test was rather useful and only 2 (3.5%) mentioned feeling too tired to undergo the test; only one patient preferred not to be disturbed in a routine setting, and a slight majority preferred the ultrasound test above manual palpation of the uterine fundus. Fairly good inter-observer variability is visually represented in Figure 2. This is further demonstrated in Table 3, which also shows that fixed bias existed when comparing midwives with experienced gynaecologic sonographers; midwives tended to systematically underestimate uterine length. Figure 3 shows Bland-Altman plots for inter-observer variability for all measurements taken; limits of agreement were smaller in the more experienced sonographers. Table 4 represents the risk for fixed and proportional biases, which do not appear to be present.

Discussion

This study represents an innovative evaluation of women's and midwives perspectives on routine postpartum ultrasound. The study was performed in a single academic unit and further research should focus on non-academic centres and also on performing postpartum ultrasound with a portable machine in a home setting. Before any introduction into general clinical practice, it is necessary that all advantages or disadvantages for performing routine ultrasound in the postpartum period are thoroughly studied. The introduction of routine postpartum ultrasound might potentially lead to overdiagnosis as an asymptomatic patient with an ultrasound image suggesting retained products of conception could be treated unnecessarily; on the other hand it allows the possibility of offering a prophylactic approach before the onset of complications such as infection or bleeding [5].

The majority of midwives regarded systematic routine ultrasound of the uterus in the postpartum period as feasible, but there was concern that not enough time would be available. About half of the midwives in this academic centre considered ultrasound to be a task for a medical doctor. However, the outcome of this study cannot be easily generalised. In Belgium ultrasound is not considered a competency of the midwife and there is no formal training in ultrasound provided specifically for midwives. Even routine ultrasound during pregnancy is done by gynaecologists; in the current centre and others midwives do perform a basic routine scan but always under direct supervision of a gynaecologist. In other countries midwives are more accustomed to providing ultrasound to pregnant women, which might result in an even higher rate of acceptance for the introduction of ultrasound in the postpartum period. On the other hand it is noteworthy that over 90% of the midwives in this study were convinced they would be able to perform the ultrasound after training and the majority thought the results would be similar to those performed by physicians.

The midwives in this study were quite convinced about the usefulness of postpartum ultrasound as three out of four considered it a useful aid to detect retained products of conception. However, about half of the midwives considered it not to be of added value to screen for retained products of conception in every woman after delivery. These differences in opinion reflect the lack of knowledge and the lack of scientific studies on this subject.

Assessment of the reproducibility of simple ultrasound measurements (uterine length and width and maximal endometrial thickness) showed that even with minimal experience and after only two hours of training, limits of agreement were acceptable. The higher reproducibility of the experienced gynaecologic ultrasonographer compared to the young trainee was expected, but the differences seemed not to be clinically relevant and actually measuring the endometrium seems highly reproducible from early on in training. It is possible that in daily practice reproducibility and inter and intra-observer variability would be different because all participants in this study were aware that the reproducibility study was being conducted (Hawthorne effect).

Concerning the experience of the recently delivered mothers, we should note that selection bias was possible; examinations were only performed during weekdays and when all ultrasound operators were available; in future research it would be important to examine the experience of every mother and also examine reasons why they would not like to have ultrasound performed in the postpartum period.

In a further stage of this research the authors will use the image data from this pilot study to improve training. The study only considered feasibility and reproducibility, and the utility of routine postpartum ultrasound is the subject of ongoing research.

Conclusion

The majority of midwives in the present sample considered routine postpartum ultrasound feasible by the midwife after appropriate training but the added value of this test should be confirmed by larger scale prospective studies. Reproducibility is high after minimal training. Recently delivered women also seem to prefer this visual method as opposed to traditional manual palpation.

Conflict of Interest

The authors declare no competing interests.

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Corresponding Author:
YVES JACQUEMYN, M.D., PhD
ObGyn UZA
Wilrijkstraat 10,
2650 Edegem (Belgium)
e-mail: Yves.Jacquemyn@uza.be