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Original Article

# Comparing transabdominal and transvaginal ultrasound-guided follicular aspiration: A risk assessment formula

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ABSTRACT

*Objective:* We sought to identify patients at risk of incomplete transvaginal oocyte retrieval, develop a risk assessment formula to identify patients who would benefit from a transabdominal approach, and compare complication and pregnancy rates between these two approaches.
*Materials and Methods:* In this retrospective case control study in a private *in vitro* fertilization center, 95 cases of women undergoing transabdominal follicular aspiration for oocyte retrieval (15 transabdominal only and 80 transabdominal and vaginal combined) were compared with 278 controls of women undergoing the transvaginal aspiration only. Transabdominal oocyte retrieval was performed when one or more ovaries could not be retrieved via the transvaginal approach. Main study outcomes included need for transabdominal retrieval, pregnancy rates, and complications.
*Results:* A risk assessment scoring system was developed as follows: difficulty seeing ovaries on ultrasound (+4), history of pelvic surgery (+3), and body mass index of 30 kg/m$^2$ or greater (+2). With a cutoff score of 4 or greater, the overall sensitivity is 75%, specificity is 80%, positive predictive value is 57%, and negative predictive value is 90%. No statistically significant differences were found for pregnancy rates or complications.
*Conclusion:* The transabdominal approach is an alternative option that would increase the total number of oocytes retrieved with no statistical difference in complication or pregnancy rates. We also developed a scoring system that can serve as a useful screening tool for identifying women at increased risk of transabdominal oocyte retrieval.


## Introduction

Oocyte retrieval is achieved almost exclusively by the transvaginal ultrasound-guided (TVUS) follicle aspiration method [1,2]. Before TVUS-guided aspiration, oocytes were aspirated under direct visual guidance via laparoscopy or via transabdominal approach [3].

Several studies have compared laparoscopic [4], transabdominal, and transvaginal follicular puncture and aspiration. Transvaginal follicular aspiration is usually preferred due to its shorter operation time and less invasive nature, but the transabdominal ultrasound-guided (TAUS-guided) follicular aspiration is considered a safe and efficacious procedure in women with ovaries inaccessible by TVUS [5]. The TAUS oocyte retrieval method is still used and published in case reports in women with radical hysterectomies, transposed ovaries [6,7], and Müllerian agenesis [8–10].

There may be a larger role presently for an increased utilization of transabdominal retrievals due to an increasing body mass index (BMI) in the U.S. population [11]. As the BMI increases, there is an increase in anatomic distortion, which contributes to

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decreasing ultrasound image quality and difficulties in identifying and accessing ovaries from the transvaginal approach [12]. We have developed a risk assessment scoring system to identify women undergoing *in vitro* fertilization (IVF) who are at risk of requiring TAUS as compared with TVUS oocyte retrieval. The purpose of this study is to determine factors requiring TAUS oocyte retrieval due to an inability to retrieve all oocytes transvaginally and evaluate its complications and effects on pregnancy rates. We wanted to evaluate if an increased BMI would be a risk factor, making it less likely to retrieve all oocytes by the traditional transvaginal aspiration approach. We evaluated additional risk factors (fibroids, prior surgery, infection, and endometriosis) to see whether these factors show a difference in the ability to retrieve oocytes and have an impact on pregnancy rates or complications.

## Materials and methods

### *Participants*

This is a retrospective case control study of women undergoing IVF who had underwent either TVUS or TAUS oocyte retrieval at a private infertility center. Institutional Review Board approval from North Shore-Long Island Jewish Health System was obtained. At retrieval, an attempt was made to access the ovaries transvaginally but if TVUS aspiration was not possible for one or both ovaries, transabdominal aspiration was performed to maximize the number of oocytes retrieved. Prior to proceeding with TAUS retrieval, the following steps were performed in an attempt to access the ovaries transvaginally: (1) transabdominal pressure, (2) cervical traction, and (3) reverse Trendelenburg. If these steps failed to provide transvaginal access to one or both ovaries, then a transabdominal approach was attempted. Cases (the transabdominal group) included patients with oocyte retrieval using TAUS exclusively or oocyte retrieval using a combination of TAUS and TVUS. Combined retrievals were defined as cases in which TVUS retrieval was achieved in one ovary but only TAUS in the contralateral ovary. Controls were selected as the subsequent three transvaginal oocyte retrievals. A total of 373 cases were obtained for this study. Inclusion/exclusion criteria were applied to both groups. The study period was from January 18, 2012, to October 9, 2013.

### *Inclusion criteria*

Inclusion criteria were patients seeking fertility who had oocyte retrievals. Data were collected in a 3:1 ratio where 278 (74.5%) underwent vaginal oocyte retrieval, and 95 (25.5%) underwent transabdominal oocyte retrieval. TAUS oocyte retrieval included 15 patients who had TAUS oocyte retrieval exclusively and 80 patients who had combined transvaginal/transabdominal oocyte retrieval. Cases within each group were randomly assigned to be in the derivation sample ($n = 186$) for the validation sample. Derivation was used to identify factors that differentiated transabdominal from vaginal cases and build a scale. The validation sample was then used to examine the utility of the scale and calculate diagnostic efficiency scores. These procedures are consistent with those utilized by other researchers attempting to build detections scales [13].

### *Exclusion criteria*

Patients who had incomplete documentation were excluded from the study.

### *Variables of interest*

Data were collected using a standardized form to review medical records. For each case, we recorded whether the patient had required TAUS oocyte retrieval or not. Other variables included BMI and history with the following considerations: laparoscopic surgery, history of laparotomy or pelvic surgery including cesarean section and myomectomies, presence of leiomyomas, polycystic ovarian syndrome (PCOS), ovaries difficult to see with TVUS, parity, sexually transmitted disease including pelvic inflammatory disease and tubo-ovarian abscesses, ectopic pregnancy, and endometriosis. We also compared pregnancy rates and time of procedure. Difficult to see ovaries with TVUS was defined as the inability to see one or both ovaries using a TVUS after the following steps: (1) transabdominal pressure, (2) cervical traction, and (3) reverse Trendelenburg. Complications were defined as excessive bleeding requiring more than vaginal sutures for hemostasis including blood transfusion, infections, or hospital admissions. Postoperative pain in both groups was also measured as follows: patients with “mild pain” were defined as those receiving one to two tablets of acetaminophen (500 mg) in the postoperative period and patients with “moderate to severe pain” were defined as those receiving one to two doses of ketorolac (30 mg) intravenous push.

### *Statistical analysis*

Categorical variables for patients who received TAUS procedures were compared with those of patients who underwent TVUS retrieval procedures using Pearson Chi-square tests ($\chi^2$). Chi-square tests were used to examine whether there were differences in pregnancy rates and pain status across the TVUS and TAUS groups. We used Student *t* tests to compare dimensional variables (e.g., age). For variables that differed significantly between groups, we calculated sensitivity (Se), specificity (Sp), positive likelihood ratio (LR+), and negative likelihood ratio (LR−).

We conducted multiple logistic regression analysis, with a forward stepwise procedure, to identify an optimal model for detecting individuals requiring transabdominal procedures [14]. Only variables that differed significantly across patient groups in the univariate analyses were utilized in the multiple logistic regression analysis. This approach has been employed in similar studies [15]. Based on the findings from the multiple logistic regression analysis, we weighted the value of each variable. These weighted scores were summed to create a scale score. We then calculated Se, Sp, LR+, LR−, odds ratio (OR), positive predictive value (PPV), and negative predictive value (NPV) for multiple cutoff scores. Because prevalence rates for transabdominal procedures may vary across populations, diagnostic efficiency scores for multiple cutoff scores were calculated and reported. This allows clinicians to adjust risk thresholds based on specific needs and prevalence rates for various populations.

## Results

### *Demographics and complications*

The average age (in years) for the study sample was 37.60 (standard deviation 5.15). Regarding ethnic background, 225 (59.3%) cases were identified as white/Caucasian, 75 (19.8%) for black/African American, 50 (13.2%) Hispanic/Hispanic American, 18 (4.7) Asian/Asian American, and 11 (2.9%) “others.” Of these cases, 278 (74.5%) underwent TVUS oocyte retrieval and 95 (25.5%) underwent TAUS oocyte retrieval. The TVUS group had an