

ULTRASOUND SEVERITY ASSESSMENT IN OVARIAN HYPERSTIMULATION SYNDROME (OHSS): A NARRATIVE REVIEW AND PROPOSED EXPLORATORY SCORE WITH HEMATOCRIT AND SERUM ALBUMIN

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ABSTRACT

Background: Ovarian hyperstimulation syndrome (OHSS) is an iatrogenic complication of ovarian stimulation that ranges from abdominal discomfort and ovarian enlargement to hemoconcentration, ascites, pleural effusion, renal dysfunction, thrombosis, and hemodynamic compromise. Existing severity systems integrate clinical, laboratory, and imaging findings, but bedside imaging is often reported descriptively rather than through a reproducible composite measure. **Objective:** To critically review ultrasound and laboratory evidence in OHSS and propose an explicitly exploratory imaging severity score for standardized reporting and prospective validation. **Methods:** A focused narrative review of society guidelines, indexed clinical studies, monitoring literature, and prediction-model reviews was conducted through 18 June 2026. The synthesis emphasized ovarian size, ascites distribution, pleural effusion, hematocrit, and serum albumin. **Results:** No validated stand-alone ultrasound severity score or published correlation coefficient linking a composite sonographic score with hematocrit or albumin was identified. A seven-point framework is proposed using largest ovarian diameter (0-2 points), ascites distribution and burden (0-3 points), and pleural effusion (0-2 points). A higher score is biologically expected to coexist with greater capillary leak, rising hematocrit, and falling albumin, but laboratory and clinical red flags override the imaging category. **Conclusion:** The proposed score may improve reporting consistency and communication across fertility, radiology, and emergency services. It is hypothesis-generating and must not replace guideline-based clinical severity assessment. Prospective multicenter validation is required before use as a decision rule.

Keywords: Ascites, Hematocrit, Ovarian hyperstimulation syndrome, Pleural effusion, Serum albumin, Severity assessment, Ultrasound

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INTRODUCTION

Ovarian hyperstimulation syndrome is a potentially serious complication of controlled ovarian stimulation. The clinical spectrum extends from ovarian enlargement, abdominal discomfort, and nausea to large-volume ascites, pleural effusion, oliguria, acute kidney injury, electrolyte disturbance, venous or arterial thrombosis, respiratory compromise, and shock. Modern prevention strategies have reduced risk, but clinically significant cases still require rapid recognition and coordinated management.^{1-4,8}

Current professional guidance emphasizes individualized stimulation, gonadotropin dose adjustment, choice of final oocyte-maturation trigger, freeze-all strategies when appropriate, and careful monitoring of high-response patients. Once symptoms develop, severity assessment remains multimodal: history and examination define the clinical syndrome; laboratory testing evaluates intravascular contraction and organ dysfunction; and imaging documents ovarian enlargement and third-space fluid.^{1,2,4,9}

Ultrasound is well suited to serial bedside assessment because it can measure both ovaries, demonstrate multicystic morphology, map peritoneal fluid, guide drainage when clinically indicated,

and detect pleural fluid when thoracic imaging is added. Nevertheless, ovarian size, ascites, and pleural effusion are commonly reported as separate descriptive findings. The resulting variation in wording makes serial comparison and communication between fertility units, emergency departments, and radiology services less consistent.^{3,10-12}

This review therefore has two linked aims: first, to critically appraise the evidence connecting imaging findings with hematocrit and serum albumin; and second, to propose a transparent, exploratory ultrasound score that standardizes description without claiming validated prognostic performance.

CURRENT OHSS SEVERITY CLASSIFICATION SYSTEMS

Historical and contemporary OHSS classifications combine symptoms, ovarian enlargement, ascites, laboratory abnormalities, and complications in different ways. The Golan and Navot systems established clinically recognizable grades, while current guidance provides broader diagnostic and management frameworks. None of these systems was designed as a stand-alone numerical ultrasound score. Table 1 summarizes the principal differences relevant to imaging.^{1,3,5-7}

Table 1. Comparison of established OHSS severity frameworks with the proposed imaging score

Framework	Core basis	Role of imaging and laboratory data	Principal value and limitation
Golan classification (1989)	Five grades based on symptoms, ovarian enlargement, and ascites.	Ultrasound-confirmed ascites and ovarian enlargement contribute to higher grades; laboratory integration is limited.	Historically influential and simple, but semiquantitative and based on older practice.
Navot classification (1992)	Severe and critical categories incorporating systemic complications.	Adds hemoconcentration, renal dysfunction, thromboembolism, respiratory compromise, and tense ascites/hydrothorax.	Clinically comprehensive, but not an imaging measurement system.
RCOG Green-top Guideline No. 5, 4th ed. (2026)	Integrated mild, moderate, severe, and critical assessment for diagnosis, monitoring, and management.	Uses symptoms, ovarian size, ascites, hematocrit, albumin, renal function, and complications; the most severe feature determines concern.	Contemporary guideline framework; ultrasound findings are not converted into a composite numeric burden.
ASRM guideline (2024) and ESHRE/British Fertility Society guidance	Risk reduction, prevention, monitoring, and treatment recommendations.	Recognize ovarian response, ultrasound findings, symptoms, and laboratory abnormalities within overall care.	Evidence-based clinical guidance, but no validated bedside ultrasound severity score.
Proposed exploratory score	Three ultrasound domains scored from 0 to 7.	Largest ovarian diameter, ascites distribution/burden, and pleural effusion are recorded separately and summed.	May standardize reporting; thresholds and outcome associations require validation.

REVIEW METHODOLOGY

A focused narrative review was selected because the purpose was to integrate guideline concepts, imaging practice, and laboratory physiology and to formulate a testable reporting framework rather than to estimate a pooled treatment effect. The search was updated on 18 June 2026. PubMed/MEDLINE, the Cochrane Library, official society guidance, and reference lists of relevant reviews and primary studies were examined. Search concepts included ovarian hyperstimulation syndrome, ultrasound or ultrasonography, ovarian size or volume, ascites, pleural effusion, hematocrit or haematocrit, albumin, severity, monitoring, prediction, and recovery.

Titles and abstracts were screened for direct relevance to OHSS diagnosis, severity assessment, imaging, laboratory markers, monitoring, or outcomes. Full texts or indexed records were then checked for methodological relevance and bibliographic accuracy. Because this was a narrative rather than systematic review, duplicate independent screening, a PRISMA flow diagram, and a formal risk-of-bias instrument were not used. The final synthesis comprised the 31 sources cited in this manuscript. Because the review was not prospectively registered or conducted as a systematic review, a PRISMA-style record-count cascade is not reported.

Table 2. Transparent search and selection approach

Component	Approach	Purpose
Search date	Search updated through 18 June 2026.	Defines the evidence cutoff.
Sources	PubMed/MEDLINE, Cochrane Library, official ASRM, ESHRE, British Fertility Society and RCOG guidance, and backward/forward citation checking.	Prioritizes indexed primary evidence and current professional guidance.
Core search concepts	(OHSS OR ovarian hyperstimulation syndrome) AND (ultrasound OR ultrasonography OR ovarian size OR ovarian volume OR ascites OR pleural effusion OR hematocrit OR haematocrit OR albumin OR severity OR monitoring).	Captures imaging, biochemical, and clinical severity literature.
Eligibility focus	Guidelines, reviews, cohort or case-control studies, monitoring studies, prediction models, and studies describing imaging or laboratory trajectories.	Supports a clinically interpretable synthesis.
Selection and synthesis	Relevance screening followed by bibliographic verification; 31 cited sources included in the final narrative synthesis.	Avoids unsupported claims while acknowledging the non-systematic design.
Exclusions	Reports unrelated to OHSS severity, inaccessible or unverifiable citations, and sources that did not inform imaging, laboratory interpretation, monitoring, or outcomes.	Reduces citation noise and duplication.

PATHOPHYSIOLOGICAL BASIS FOR IMAGING-LABORATORY ASSOCIATIONS

The defining biological process in clinically significant OHSS is increased vascular permeability, driven largely by vascular endothelial growth factor and other vasoactive pathways after

ovarian stimulation and luteinization. Protein-rich fluid leaves the intravascular compartment and accumulates in the peritoneal, pleural, and occasionally pericardial spaces. At the same time, the circulating plasma volume contracts.^{8,19}

This shared mechanism produces anatomically visible and biochemically measurable consequences. Ultrasound shows

ovarian enlargement and third-space fluid. Hematocrit rises as plasma water is lost relative to red-cell mass, whereas serum albumin can fall because albumin is redistributed into extravascular fluid and because systemic illness may further alter

concentration. These variables are therefore biologically associated, but biological plausibility is not equivalent to a validated numerical correlation between a sonographic score and either laboratory marker.¹⁵⁻¹⁹

Pathophysiological Basis for Imaging-Laboratory Associations in OHSS

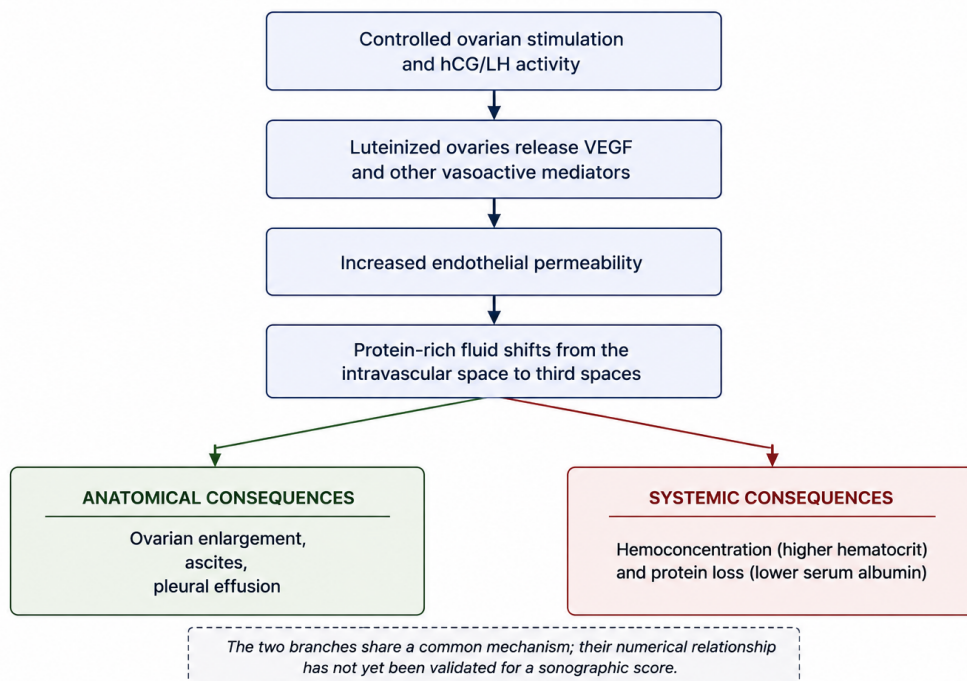


Figure 1. Pathophysiological basis for the expected association between imaging burden, hematocrit, and serum albumin in OHSS. Source: Original schematic prepared for this review; no patient image is used.

ULTRASOUND PARAMETERS FOR SEVERITY ASSESSMENT

Ovarian enlargement and multicystic morphology

Both ovaries should be measured in three orthogonal planes whenever their margins can be distinguished. The largest single diameter is easy to reproduce and aligns with diameter categories used in clinical guidance. Ovarian volume may also be calculated with the prolate ellipsoid formula (length x width x depth x 0.523) and reported as a continuous value. Older studies found that baseline or pre-trigger ovarian volume was associated with

later OHSS, but they did not establish a validated post-presentation volume threshold for severe disease.^{3,13,14}

Ovarian size has important limitations. After oocyte retrieval, follicular aspiration changes ovarian geometry; very enlarged ovaries are irregular; bowel gas or tenderness can restrict visualization; and the largest ovary may not reflect systemic capillary leak. Clinical severity can therefore be high even when ovarian dimensions are not extreme. Doppler assessment and focused evaluation for torsion or hemorrhage should be added when pain is disproportionate or focal.

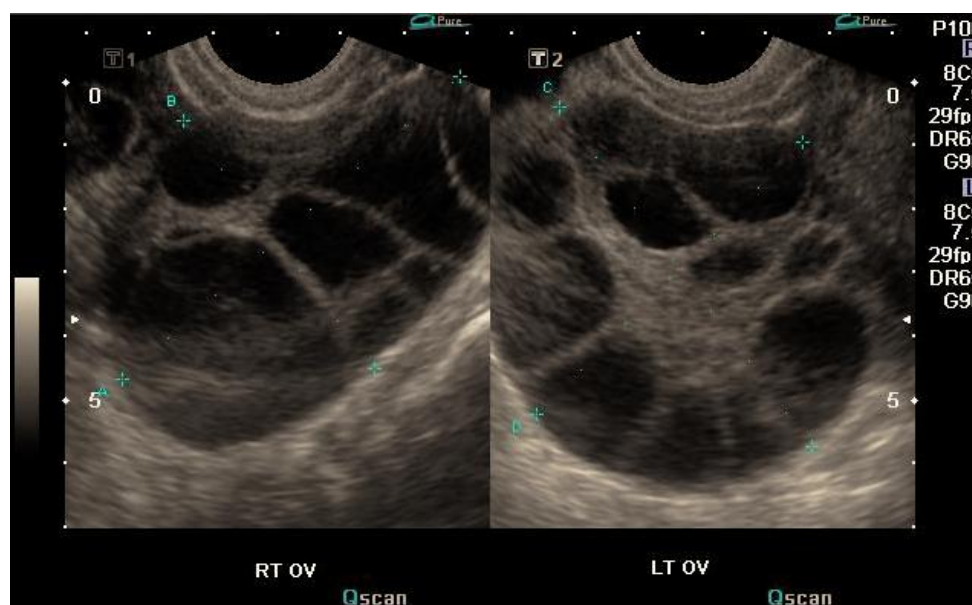


Figure 2. Bilateral enlarged multicystic ovaries on transvaginal ultrasound in ovarian hyperstimulation syndrome (OHSS)

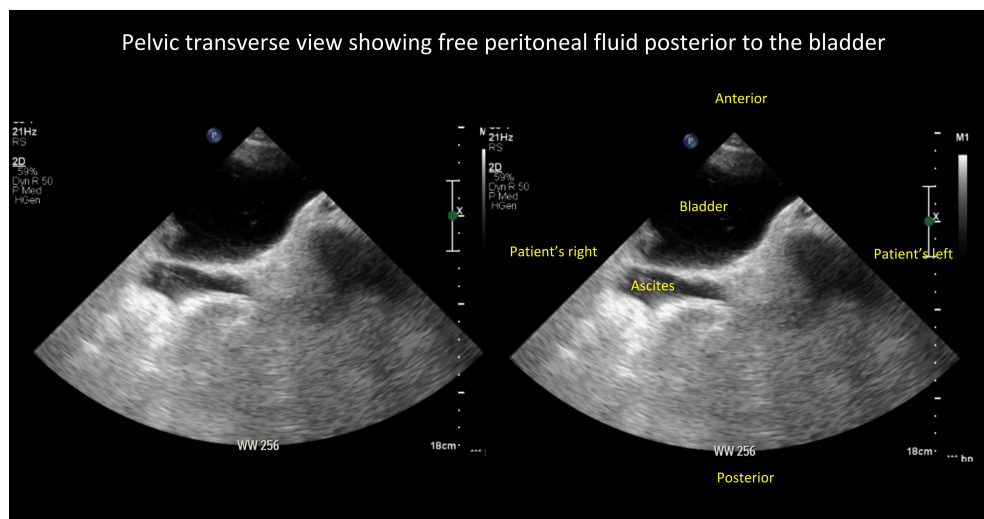


Figure 3. Pelvic ultrasound demonstrating free peritoneal fluid (ascites) posterior to the urinary bladder

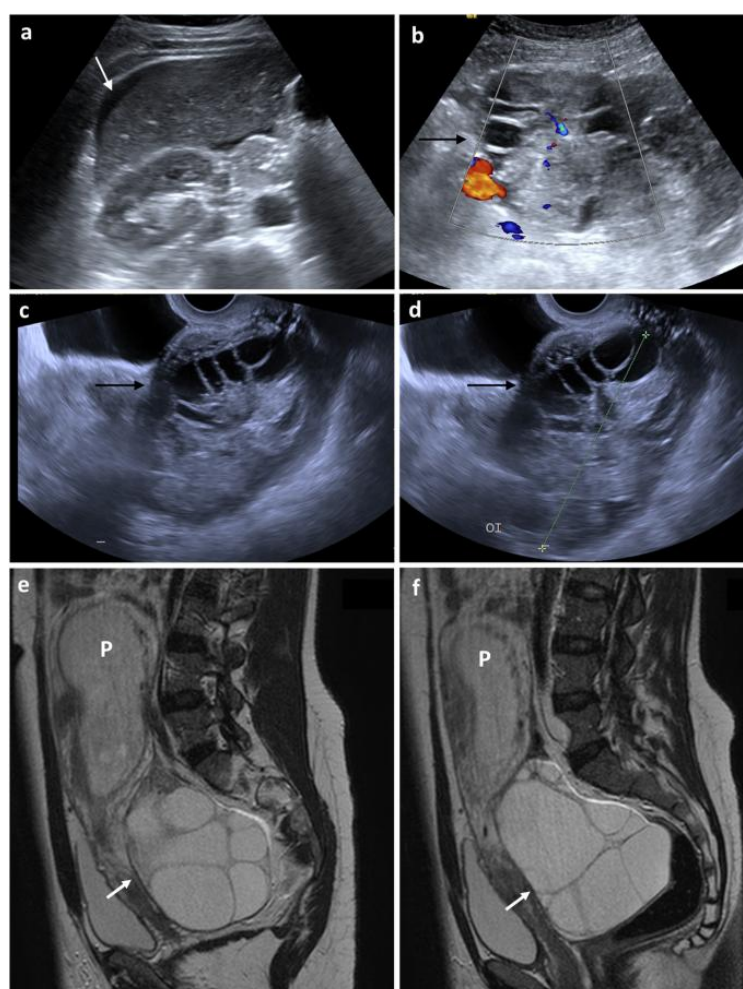


Figure 4. Multimodality imaging of OHSS showing ovarian enlargement, ascites, and pelvic MRI findings

Ascites

Ascites is the most direct sonographic manifestation of peritoneal third-spacing. The report should describe distribution rather than rely on a single pelvic measurement: pelvic-only fluid, extension into paracolic or upper abdominal spaces, or generalized fluid. A deepest vertical pocket can be recorded for serial comparison, but no universally validated pocket-depth cutoff separates moderate from severe OHSS. Patient position, bladder filling, probe pressure, and the selected compartment can materially alter the measurement.

Pleural effusion

Pleural effusion indicates thoracic extension of third-space fluid and carries more clinical significance than isolated pelvic fluid. Chest ultrasound can detect small effusions, but thoracic assessment should be targeted to respiratory symptoms, high abdominal fluid burden, or clinical concern. Effusion size, oxygenation, respiratory rate, and alternative cardiopulmonary diagnoses remain important; the mere presence of pleural fluid is not, by itself, an intensive-care indication.^{3,31}

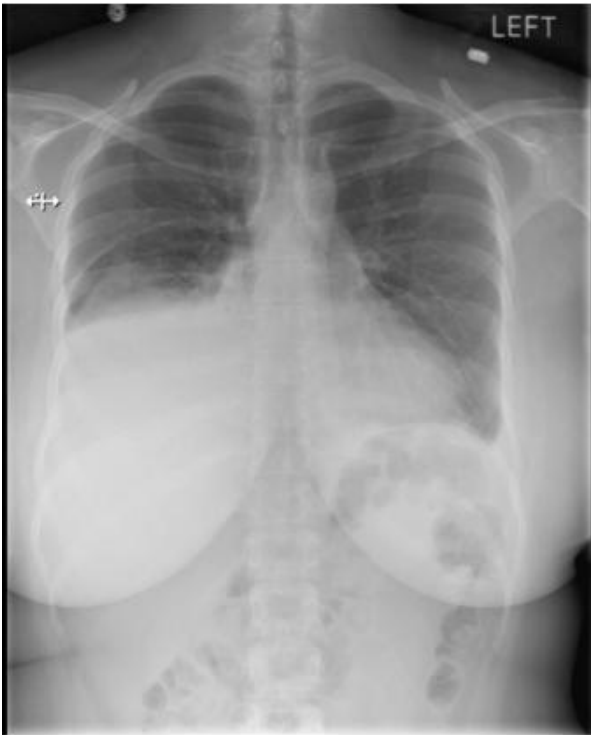


Figure 5. Chest radiograph demonstrating right-sided pleural effusion associated with severe OHSS.

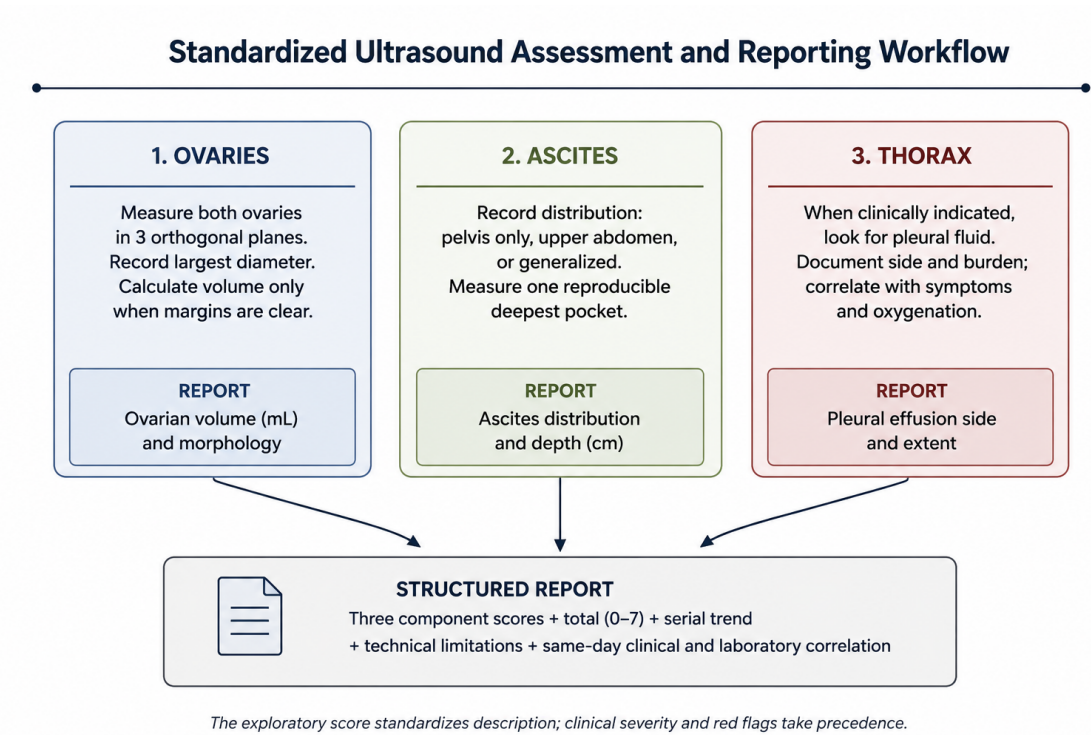


Figure 6. Standardized ultrasound assessment and reporting workflow for OHSS. Source: Original schematic prepared for this review; no patient image is used.

RATIONALE FOR SCORE DEVELOPMENT

No validated sonographic scoring system was identified that assigns evidence-derived weights to ovarian size, ascites, and pleural effusion in women presenting with established OHSS. The framework in Table 3 is therefore explicitly exploratory. Its

categories were selected to be clinically recognizable, easy to document, and compatible with contemporary guideline language. They are not presented as statistically optimized cutoffs.

Table 3. Proposed exploratory ultrasound severity score for OHSS

Domain	Finding	Points	Rationale and caveat
Largest ovarian diameter (either ovary)	<8 cm	0	Below the diameter generally used to define moderate ovarian enlargement; OHSS is not excluded.
	8-12 cm	1	Recognizable moderate enlargement category used in clinical classifications.
	>12 cm	2	Marked enlargement; report technical limitations and assess for torsion/hemorrhage when indicated.
Ascites distribution and burden	Absent	0	No sonographically visible peritoneal fluid.
	Pelvic only	1	Limited third-space fluid.
	Pelvic plus at least one upper abdominal compartment	2	More extensive peritoneal involvement.
	Generalized large-volume fluid or clear increase on serial imaging	3	High or progressing peritoneal fluid burden; “tense” ascites remains a clinical assessment.
Pleural effusion	Absent	0	No thoracic fluid documented.
	Present, unilateral or bilateral	2	Extra-abdominal third-spacing; assess respiratory status and alternative causes.
Total score	0-7	-	0-2 lower imaging burden; 3-4 intermediate imaging burden; 5-7 high imaging burden. These are not validated clinical severity grades.

The ovarian component uses largest-diameter categories rather than the original manuscript's unvalidated volume cutoffs. Volume should still be recorded continuously when feasible. Ascites receives the widest range because distribution and progression most directly reflect peritoneal fluid burden. Pleural effusion receives two points, rather than one, to acknowledge extra-abdominal third-spacing and the need for respiratory assessment. The total score is an imaging descriptor only; the highest-risk clinical or laboratory feature must override a lower score.

HEMATOCRIT AND SERUM ALBUMIN

Hematocrit is a practical marker of hemoconcentration and intravascular contraction. Classic physiological work showed that hematocrit, unlike leukocyte or platelet count, tracked the neurohormonal response to volume depletion in OHSS. A hematocrit above 45% is used as a severe feature in established clinical classifications, but serial change and the patient's

baseline value are often more informative than a single threshold.^{3,15,16}

Serum albumin provides complementary information about protein redistribution and overall illness. Hypoalbuminemia is included among severe features in contemporary classifications, yet the evidence linking albumin to imaging burden is limited. In a small case-control study, baseline albumin was lower among women with polycystic ovaries who later developed severe rather than moderate or no OHSS. This finding does not validate albumin as a direct correlate of the proposed score.^{3,17}

Serial studies support the general concept that clinical improvement, decreasing ovarian or ascitic burden, and normalization of laboratory markers occur together. However, no reviewed study reported a correlation coefficient, regression equation, or validated prediction model using the exact composite ultrasound score proposed here. The title and conclusions have therefore been revised to describe “relationships” rather than a demonstrated statistical correlation.¹⁸⁻²²

Table 4. Representative evidence relevant to imaging, hematocrit, and albumin in OHSS

Study	Design and population	Relevant finding	Interpretive limitation
Danninger et al. (1996)	Prospective ultrasound volumetry in 101 IVF patients; 15 developed OHSS.	Baseline ovarian volume was associated with later OHSS.	Prediction study before established disease; no bedside severity score or validated post-presentation cutoff.
Oyesanya et al. (1995)	Comparison of total ovarian volume before hCG administration.	Volume was higher in women who developed moderate/severe OHSS than in controls.	Small early study; not a validation of serial imaging burden.
Fabregues et al. (1998)	Physiological study of women with OHSS and recovery measurements.	Hematocrit was directly related to vasoactive markers of intravascular volume depletion.	Supports hematocrit as a severity marker, not a sonographic-score correlation.
Kaur et al. (2015)	Retrospective analysis of 225 IVF cycles; 66 high-risk women and 27 OHSS cases.	Higher hematocrit around oocyte retrieval/embryo transfer was associated with OHSS development.	Small single-center cohort; threshold differs from severe-disease classifications.
Alserri et al. (2012)	Case-control study: 49 OHSS cases and 91 controls.	Lower baseline albumin in women with polycystic ovaries who later developed severe OHSS.	Subgroup finding; requires larger validation and does not quantify imaging burden.
Lainas et al. (2014)	Small serial cohort of severe early OHSS.	Improvement in VEGF was accompanied by improvement in ultrasound and laboratory parameters.	Demonstrates parallel trajectories, not a validated composite score.

INTEGRATED CLINICAL INTERPRETATION AND TRIAGE

The proposed score is intended to standardize the imaging contribution to triage, not to determine disposition by itself. Symptoms, vital signs, urine output, weight change, pregnancy

status, renal function, electrolytes, liver tests, thrombosis risk, and access to follow-up remain essential. Clinical severity should be assigned according to established guidance, and the most concerning feature should drive escalation.^{1,3,20,31}

Table 5. Suggested use of the exploratory score alongside clinical and laboratory assessment

Imaging score or pattern	Interpretation	Suggested clinical response*
0-2 and stable findings	Lower imaging burden.	When symptoms are mild, vital signs and laboratory results are reassuring, and follow-up is reliable, outpatient monitoring may be considered by the treating team with explicit safety-net advice.
3-4, a rising score, or increasing fluid on serial imaging	Intermediate or progressing imaging burden.	Same-day fertility/gynecology review; complete blood count, electrolytes, creatinine, liver tests, and albumin; reassess hydration and urine output; repeat imaging/laboratory testing according to the clinical trajectory, commonly within 24-48 hours.
5-7	High imaging burden.	Urgent hospital-based assessment is appropriate. Determine need for admission, thromboprophylaxis, fluid-balance monitoring, drainage procedures, and respiratory support using guideline-based clinical criteria.
Any score with a red flag	Imaging score overridden by clinical/laboratory severity.	Urgent escalation for dyspnea or hypoxemia, hypotension/syncope, oliguria, thrombotic symptoms, rising hematocrit >45%, falling albumin, renal or electrolyte dysfunction, rapidly accumulating fluid, or other organ compromise. Critical-care review is based on organ dysfunction, not the score alone.

*These responses are a reporting and communication framework, not a treatment protocol. Local pathways and current professional guidance take precedence.

Table 6. Practical reporting workflow for ultrasound-based OHSS assessment

Step	Report element	Purpose
1	Measure right and left ovaries in three orthogonal planes; record the largest diameter and volume when reliable.	Quantifies enlargement and supports serial comparison.
2	Describe multicystic morphology and assess for torsion, hemorrhage, or another cause of focal pain when clinically indicated.	Separates expected stimulated morphology from complications.
3	Record ascites distribution and deepest reproducible pocket; compare with prior imaging.	Characterizes third-space fluid burden and trend.
4	Document pleural effusion when chest ultrasound or other thoracic imaging is performed.	Identifies extra-abdominal third-spacing.
5	State the component scores, total exploratory score, category, and any technical limitation.	Makes the imaging impression transparent and reproducible.
6	Correlate with same-day symptoms, vital signs, urine output, hematocrit, albumin, creatinine, and electrolytes.	Aligns anatomic burden with systemic severity.
7	Recommend follow-up or urgent assessment using clinical red flags rather than score alone.	Prevents inappropriate reassurance from a low imaging score.

DISCUSSION

This review reframes ultrasound as a standardized component of OHSS assessment rather than an isolated list of findings. Ovarian enlargement, ascites, and pleural effusion represent related but non-identical aspects of disease: ovarian size reflects the stimulated organ response; ascites reflects peritoneal capillary leak; and pleural effusion indicates thoracic extension. Summing these findings may improve communication during first presentation and serial follow-up, but the score should remain visibly labeled “exploratory” until validated.

The proposed framework differs from existing classifications in purpose. Golan, Navot, RCOG, ASRM, ESHRE, and British Fertility Society guidance support clinical classification, prevention, or management. The new score is narrower: it structures the imaging report and allows investigators to test whether a quantitative imaging burden adds information beyond symptoms and laboratory markers. It should not be used to relabel a clinically severe patient as “mild.” 1-7

The biological direction of association is coherent. Increasing third-space fluid should generally accompany worsening intravascular contraction, rising hematocrit, and declining albumin. Yet individual discordance is expected because hydration, timing, baseline hematocrit, albumin synthesis, pregnancy-related changes, and prior interventions alter laboratory values. Similarly, ovarian size can remain large while systemic leakage improves. Serial trajectories may therefore be more informative than one-time measurements.

Risk prediction literature increasingly combines patient characteristics, ovarian reserve, follicular response, hormones, and stimulation protocol. These models address the probability of developing moderate-to-severe OHSS rather than the bedside imaging burden after presentation. PCOS-specific work and umbrella reviews reinforce the importance of prevention and individualization, while artificial-intelligence reviews show growing interest in data-driven ovarian stimulation. A simple, transparent imaging score may complement rather than compete with these models.^{23-26,30}

Structured reporting may be particularly useful when women present outside the treating fertility center. Emergency-department utilization, patient-experience research, and intensive-care data demonstrate that OHSS affects multiple services and that clear communication is clinically important. A component-based score makes the source of the total visible and reduces ambiguity between terms such as “small,” “moderate,” and “large” fluid collections.^{28,29,31}

STRENGTHS AND LIMITATIONS OF CURRENT IMAGING-BASED SEVERITY ASSESSMENT

Ultrasound is portable, repeatable, radiation-free, and capable of evaluating the ovaries and peritoneal fluid at the bedside. It also supports procedure planning and targeted thoracic assessment. These advantages make it well suited to serial monitoring and to standardized templates.

Important limitations remain. Ovarian measurements are operator dependent, irregular ovaries do not conform perfectly to an ellipsoid, and post-retrieval anatomy may reduce the relationship between size and systemic illness. Ascites depth varies with patient position, bladder filling, respiration, and selected compartment. A single deepest pocket can increase or decrease even when total fluid changes little. Small pleural effusions may be missed if the thorax is not examined, whereas an effusion can have causes unrelated to OHSS.

Interobserver agreement for the proposed categories is unknown. The score also assigns equal numerical increments to findings whose prognostic importance may not be linear. Pleural effusion is weighted more heavily than in the original draft, but that weighting remains a clinical rationale rather than a data-derived coefficient. These limitations should be stated in every research application of the score.

LIMITATIONS OF THIS REVIEW AND PROPOSED SCORE

The review is narrative and did not use a preregistered protocol, duplicate screening, or formal risk-of-bias grading. The evidence base includes older studies because contemporary imaging-specific validation studies are sparse. The score was derived from guideline categories, pathophysiology, and reporting practicality rather than an individual-patient dataset. Consequently, the category thresholds, relative weights, and suggested interpretation bands are provisional. No statistical correlation between this score and hematocrit, albumin, hospitalization, thrombosis, drainage, renal impairment, or length of stay has yet been demonstrated.

FUTURE DIRECTIONS

Prospective multicenter validation should enroll consecutive patients with suspected OHSS and use a prespecified imaging protocol. Interobserver reliability should be quantified with weighted kappa statistics for categorical components and intraclass correlation coefficients for continuous ovarian and fluid measurements. Feasibility, missing-data frequency, examination time, and patient discomfort should also be reported.

Criterion and prognostic validity should be evaluated against guideline-based severity categories and clinically important outcomes, including hospital admission, paracentesis or thoracentesis, acute kidney injury, thrombosis, oxygen or ventilatory support, critical-care admission, and length of stay. Receiver-operating-characteristic analysis, calibration, sensitivity, specificity, likelihood ratios, and decision-curve analysis would determine whether the score adds value beyond symptoms and routine laboratory data.

Serial change deserves separate study because a falling or rising score may be more informative than the baseline value. Automated ovarian segmentation, fluid-volume estimation, and decision support could reduce measurement variability, but artificial-intelligence systems will require external validation, transparent failure analysis, and clinician oversight before implementation.^{18,21,30}

CONCLUSION

A structured ultrasound score can translate ovarian enlargement, ascites distribution, and pleural effusion into a transparent 0-7 imaging descriptor for OHSS. Hematocrit and serum albumin provide complementary evidence of intravascular contraction and protein loss, but the current literature does not establish direct statistical correlation with this composite score. The framework is therefore exploratory and intended to improve reporting consistency and enable prospective research. Guideline-based clinical severity assessment and urgent clinical red flags must always take precedence.

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ETHICAL CONSIDERATIONS AND FIGURE STATEMENT

This narrative review did not involve recruitment of participants, access to identifiable patient data, or use of patient-derived clinical images. Figures 1 and 2 are original conceptual schematics prepared for this manuscript. Institutional review board approval and individual informed consent were therefore not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Figures

Figure 3. Bilateral enlarged multicystic ovaries on transvaginal ultrasound in ovarian hyperstimulation syndrome (OHSS).

Figure 4. Pelvic ultrasound demonstrating free peritoneal fluid (ascites) posterior to the urinary bladder.

Figure 5. Multimodality imaging findings in ovarian hyperstimulation syndrome (OHSS).

Figure 6. Chest radiograph demonstrating pleural effusion associated with severe OHSS.