

**ANALYTICAL REVIEW AND METHODOLOGICAL ASSESSMENT OF  
LIGASURE USE IN HYSTERECTOMY IN THE REPUBLIC OF UZBEKISTAN**

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**Abstract**

**Relevance.** Hysterectomy remains one of the most common procedures in gynecology and gynecologic oncology [1]. In Uzbekistan, not only surgical efficacy but also rational allocation of high-technology consumables, hemostatic safety, reduction of perioperative risks, and economic justification for the implementation of new instruments are of particular importance [5, 7].

**Objective.** To conduct an analytical review and methodological assessment of the bipolar vessel-sealing system LigaSure in hysterectomy, determine rational indications and limitations, and propose a framework for future clinical evaluation in gynecologic oncology practice in the Republic of Uzbekistan.

**Materials and Methods.** An analytical review of clinical studies, systematic reviews, health technology reports, and guidelines addressing the use of advanced bipolar vessel-sealing systems in abdominal, laparoscopic, vaginal, and radical hysterectomy was performed [1, 3-5]. A methodological framework for future comparative research was developed without presenting artificially generated clinical outcomes.

**Results.** LigaSure may reduce blood loss, accelerate individual operative stages, and improve the reproducibility of hemostasis, particularly in patients with obesity, a large uterus, extensive adhesions, re-operative procedures, and radical gynecologic oncology operations [3-6]. However, universal application is not always justified because of cost, risk of thermal injury, and the limited clinical significance of advantages in standard uncomplicated hysterectomies [3, 5].

**Conclusion.** For Uzbekistan, a selective model of LigaSure use appears methodologically and clinically justified [5, 7]. A retrospective-prospective study evaluating blood loss, operative duration, complications, transfusions, hospital days, and treatment costs is methodologically appropriate [3-5].

**Keywords:** Hysterectomy, LigaSure, analytical review, methodological framework, vessel sealing, gynecologic oncology, Uzbekistan.

**Introduction**

Hysterectomy is performed for benign, premalignant, and malignant uterine conditions [1]. In contemporary gynecologic surgery, the choice of surgical approach and instrumentation should be determined not only by technical availability, but also by clinical objectives, anatomical complexity, oncologic safety, surgeon expertise, and institutional resources [1, 5].

For benign indications, minimally invasive approaches are generally preferred when technically feasible. In oncologic disease, disease stage, extent of radical resection, quality of dissection, and safe management of vascular-ligamentous structures remain paramount [1, 7]. In Uzbekistan, rational implementation of surgical technologies has practical significance [7]. Gynecologic oncology services face substantial demand for specialized care and frequently manage patients with concomitant pathology, anemia, obesity, late presentation, and a need for extensive interventions [7]. In such circumstances, any costly technology must be evaluated methodologically rather than on the basis of marketing claims: which patients truly benefit from it, in which clinical scenarios it provides a meaningful advantage, and where its use may be excessive [5].

LigaSure belongs to the class of bipolar vessel-sealing systems [6]. Its mechanism of action is based on a combination of mechanical tissue compression and controlled bipolar energy, which induces denaturation of collagen and elastin and forms a durable vascular seal [6]. In surgical practice, this enables more rapid management of vascular pedicles and reduces dependence on manual suturing [3, 4, 6]. However, this technology does not eliminate the need for precise knowledge of pelvic anatomy, ureteral visualization, caution during lymphadenectomy, and strict adherence to electrosurgical safety principles [5, 6].

The scientifically correct position is that LigaSure should not be regarded as universally superior. Its efficacy depends on surgical approach, operative complexity, body mass index, uterine size, presence of adhesions, oncologic extent of intervention, surgeon experience, and hospital economic circumstances [3-5]. Therefore, the most appropriate format for the present work is an analytical review with a methodological component, rather than a report of original clinical results without verifiable patient data.

## 2. Aim and Objectives

The aim of this work is to conduct an analytical assessment of the benefits and limitations of LigaSure use in hysterectomy and to propose a methodological framework for future comparative research in the Republic of Uzbekistan.

The objectives of this work included analysis of the technology's mechanism of action; assessment of its potential impact on blood loss, operative duration, and complications; identification of clinical situations in which the method is most justified; description of cost- and safety-related limitations; and development of a framework for future research based on real, verifiable clinical data.

## 3. Materials and Methods

This work was performed as an analytical review and methodological study. The analysis included publications addressing the use of LigaSure and other advanced bipolar vessel-sealing systems in hysterectomy [3-6]. During interpretation of the literature, surgical type, approach, case complexity, oncologic component, study endpoints, and the clinical significance of identified differences were considered separately [3-5].

The methodological approach is based on the principle of differentiated technology assessment. This means that one vessel-sealing system cannot automatically be considered

equally beneficial for uncomplicated laparoscopic hysterectomy, open surgery in an obese patient, radical hysterectomy for cervical cancer, or surgery after radiation therapy [3-5]. For each scenario, blood loss risk, operative time, probability of complications, transfusion requirements, and economic appropriateness must be evaluated separately [5].

This article does not present original clinical results and does not use artificially generated numerical data. The methodological section is intended to prepare for future research and subsequent completion with data from medical records, operative logs, anesthesia charts, and institutional registries.

#### 4. Analytical Review of LigaSure

A key advantage of LigaSure is the standardization of hemostasis [6]. In hysterectomy, this is particularly important during division of the round ligaments, management of the uterine vessels, transection of the cardinal and uterosacral ligaments, and parametrial dissection [1, 6]. By combining tissue grasping, coagulation, and division, the number of surgical manipulations is reduced, which may decrease operative time at individual stages [3, 4, 6].

The advantages of the method are most evident in operations of increased technical complexity [4, 5]. Such situations include obesity, a large uterus, extensive adhesions, re-operative procedures on the pelvic organs, endometriosis, tumor involvement, radical hysterectomy, and concurrent hysterectomy with lymphadenectomy [4, 5]. In these conditions, manual ligation or suturing may be more time-consuming and technically cumbersome, whereas hemostasis control requires high reproducibility [4, 6].

In gynecologic oncology, LigaSure may provide additional value in the management of parametrial adipose tissue and vascular bundles [5, 6]. However, oncologic operations are not evaluated solely by blood loss and operative duration. The extent of radical resection, quality of lymph node dissection, and prevention of ureteral, bladder, bowel, major vessel, and neural injury remain more important [1, 5]. Therefore, LigaSure should be viewed as an instrument, not as an independent determinant of oncologic success.

In standard total laparoscopic hysterectomy, the literature indicates a possible reduction in blood loss and operative time compared with conventional bipolar energy, although the magnitude of this effect may be modest [3]. For dissertation research, this is a crucial point: it is scientifically stronger not to claim that the technology is "always better", but to demonstrate in which patient subgroups it provides true clinical and economic value [3, 5].

#### 5. Limitations and Risks of the Method

The first limitation is cost. Within Uzbekistan's healthcare system, procurement of disposable or limited-reuse instruments must be justified by measurable clinical benefit [5, 7]. If LigaSure is used in every uncomplicated operation, its economic efficiency may be questionable [3, 5]. A more rational approach is selective application in high-risk patients, patients with complex anatomy, or patients requiring extensive oncologic interventions [4, 5].

The second limitation is the risk of thermal injury. During hysterectomy, the ureter, bladder, rectum, iliac vessels, and obturator nerve may be located close to the energy application zone [1, 5]. Thermal trauma is dangerous because it may not manifest immediately, but rather in

the late postoperative period as necrosis, fistula, or stricture [5, 6]. Therefore, clear visualization of critical structures and maintenance of a safe distance before device activation are essential [5, 6].

A third limitation relates to lymphatic vessels. During pelvic and para-aortic lymphadenectomy, prevention of lymphorrhea and lymphocele is important [5]. Lymphatic vessels are not always sealed as reliably as arteries and veins; therefore, large lymphatic collectors should receive additional clip ligation when necessary [5]. Complete replacement of mechanical control of lymphatic vessels with energy-based instruments may be methodologically and clinically inappropriate [5].

A fourth limitation is dependence on surgeon training. LigaSure simplifies certain operative stages but does not replace surgical experience. Errors involving energy instruments near the ureter or intestine may have more serious consequences than slower but anatomically controlled ligation. Therefore, implementation of the technology requires training, standard operative protocols, and internal audit of complications.

Table 1. Methodological Assessment of Rational LigaSure Use in Hysterectomy

Assessment Criterion	When Application is Justified	When Benefit is Questionable	What to Record in Registry
<b>Clinical Complexity</b>	Obesity, large uterus, adhesions, re-operative procedures	Small uterus, uncomplicated anatomy	BMI, uterine size, adhesions
<b>Oncologic Extent</b>	Radical hysterectomy, lymphadenectomy, parametrial dissection	Uncomplicated benign procedure	Diagnosis, stage, operative extent
<b>Hemostasis</b>	Expected high blood loss, anemia, vascular bundles	Minimal vascular risk	Blood loss, transfusions, hemoglobin
<b>Safety</b>	Trained team with ureteral visualization	Inexperienced team or poor visualization	Complications, thermal injuries, conversions
<b>Economics</b>	Risk reduction and time savings justify cost	Routine use without patient selection	Instrument cost, hospital days, re-operations

### 6. Significance for Clinical Practice in Uzbekistan

For Uzbekistan, a selective rather than universal model of LigaSure use is preferable [5, 7]. This model requires preliminary assessment of surgical risk and prioritizes the technology in clinical situations in which a real clinical benefit is expected: reduction of blood loss, shortening of operative time, prevention of transfusions, reduction of complications, or improvement of safety during complex dissection [3-5].

Organizationally, it is appropriate to establish a local registry of LigaSure use in the gynecologic oncology department. This registry should be simple yet sufficient for subsequent statistical analysis. It may include age, body mass index, diagnosis, disease stage, surgical approach, operative extent, operative duration, blood loss, transfusions, complications, length of hospitalization, and cost of consumables.

Methodologically, technology assessment must include not only mean values but also subgroup analysis. For example, patients with obesity, a large uterus, adhesions, radical hysterectomy, and lymphadenectomy should be analyzed separately. This approach will

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demonstrate not generalized declarations of efficacy, but precise clinical niches in which LigaSure provides the greatest value for the healthcare system.

### **7. Methodological Framework for Future Research**

To obtain material suitable for a doctoral dissertation, a comparative retrospective-prospective study is advisable [3-5]. The study group would comprise patients who underwent hysterectomy with LigaSure application. The control group would include patients who underwent comparable procedures using standard suture ligation or conventional bipolar coagulation [3, 4]. Groups should be comparable in terms of age, body mass index, diagnosis, surgical approach, operative extent, and degree of surgical complexity.

The primary endpoint may be intraoperative blood loss or operative duration [3, 4]. Secondary endpoints may include transfusion rate, intraoperative complications, postoperative complications within 30 days, length of hospital stay, analgesic requirement, conversion of surgical access, and total economic cost per case [3-5]. Student's t-test or the Mann-Whitney U test may be used for quantitative variables depending on data distribution; the chi-square test or Fisher's exact test may be used for categorical variables.

Inclusion criteria may include planned abdominal, laparoscopic, vaginal, or radical hysterectomy; availability of complete medical documentation; and the ability to assess blood loss and operative duration. Exclusion criteria should include emergency obstetric hysterectomy, massive antecedent hemorrhage, incomplete records, and concurrent procedures that substantially distort operative duration unless analyzed separately.

An important principle is that all parameters must be verifiable through primary documentation. Artificial numerical data entry is impermissible. For dissertation defense and publication in peer-reviewed journals, data must be verifiable through medical records, operative logs, anesthesia protocols, laboratory values, and local ethics committee approval.

### **8. Discussion**

The literature review and methodological assessment demonstrate that LigaSure has the greatest value as a tool for complex cases rather than as a mandatory standard for all hysterectomies [3-5]. This is particularly important for resource-limited countries where surgical innovation must be not only clinically attractive but also economically justified [5, 7]. Implementation of the technology without selection criteria may increase costs without proportional improvement in outcomes [5].

For doctoral dissertation purposes, the most promising approach is not a simple comparative thesis of "LigaSure versus standard technique", but a more sophisticated model: determination of predictors of technology benefit. Such predictors may include body mass index, uterine size, presence of adhesions, oncologic diagnosis, operative radicality, need for lymphadenectomy, baseline hemoglobin, and surgical team experience. Such an approach gives the work scientific novelty and practical significance.

The methodological advantage of the proposed approach is that it permits integration of clinical, technological, and economic assessment [3-5]. For the national oncologic care system, this is particularly important: decisions regarding LigaSure should be based on local

data, not only on international publications [5, 7]. In the future, such work may become the basis for a local protocol on selective use of vessel-sealing systems in gynecologic oncology.

### 9. Conclusions

- LigaSure is a contemporary bipolar vessel-sealing technology that can improve the reproducibility of hemostasis during hysterectomy [6].
- The most rational indications for its use in Uzbekistan are complex operations: obesity, a large uterus, extensive adhesions, re-operative procedures, radical hysterectomy, and gynecologic oncology cases [4, 5, 7].
- Universal use of LigaSure in all hysterectomies is not methodologically justified because of cost and potentially modest clinical benefit in standard uncomplicated procedures [3, 5].
- The main limitations of the method include cost, risk of thermal injury, dependence on surgeon experience, and the need for caution during lymphatic vessel management [5, 6].
- For doctoral dissertation purposes, the optimal format is a comparative clinical-economic study based on real patient data and mandatory statistical analysis.

### 10. Practical Recommendations

- Implement LigaSure selectively, primarily in patients with high surgical risk [4, 5].
- Ensure mandatory visualization of the ureter and critical vascular-neural structures before activation of the energy instrument [1, 5, 6].
- During lymphadenectomy, do not completely replace clip ligation or suture ligation of large lymphatic collectors [5].
- Establish a local registry of LigaSure use in the gynecologic oncology department.
- Conduct an economic evaluation for each case, including instrument cost, transfusions, complications, and length of hospitalization [5].

#### Ethical Aspects, Funding, and Author Contributions

Ethical aspects. This work is an analytical review and methodological study that does not contain individual patient medical data and does not present results of human intervention.

Future clinical research will require approval from a local ethics committee.

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Author contributions. The authors performed the literature analysis, formulated the methodological technology assessment, and proposed a research model for gynecologic oncology practice in Uzbekistan.

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