COMPARATIVE ANALYSIS OF RADIOFREQUENCY VESSEL SEALER AND ULTRASONIC VESSEL SEALER IN SURGERY

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Pharmaceutical Management

by

Chaudhary Hasmukh Naran

Under the Supervision and Guidance of

Dr. Rahul Sharma

2025

WINGLOBE
Innovations for Life!

CERTIFICATE OF INTERNSHIP

To Whomsoever it may concern

This is to certify that **Chaudhary Hasmukh Naran**, in partial fulfilment of the requirements for the award of the degree of MBA (Hospital and Health Management) / MBA (Pharmaceutical Management) / MBA (Development Management) from IIHMR University, Jaipur, has successfully completed his Internship at WINGLOBE HEALTHCARE PVT LTD during the period March 10th to June 10th , 2025.

For **WINGLOBE HEALTHCARE PVT. LTD.**

Place: **Bangalore**

Date: **15/6/25**

Kunal Kishore

WINGLOBE HEALTHCARE PVT LTD

KUNAL KISHORE

CEO

Winglobe Healthcare Pvt. Ltd.
Reg. Office:
No. 1783, 2nd Floor, Phoenix House, 19th Main Road, 1st Sector, HSR Layout, Bengaluru - 560 102 KA
Corporate Office:
GR Tower, 3rd Floor, Plot No. L-127, 4th Main Road, 14th Cross, VI Sector, HSR Layout, Bengaluru - 560 102 KA
www.winglobe.in
T: +91 80 356 94730, +91 96671 77664 | E: customercare@winglobe.in

IIHMR UNIVERSITY

CERTIFICATE

This is to certify that the dissertation title **"Comparative Analysis of Radiofrequency Vessel sealer and Ultrasonic Vessel scaler in surgery"** is a record of the research work undertaken by **Hasmukh Naran Chaudhary** in partial fulfilment of the requirements for the award of the degree of MBA-Pharmaceutical Management from the IIHMR University, Jaipur under my guidance and supervision and his approach to the research study has been sincere, scientific, and analytical.

Faculty Guide
IIHMR University, Jaipur
Date: 16.06.2025

School Dean
IIHMR University, Jaipur
Date: 16.06.2025

DECLARATION BY STUDENT

I, **Hasmukh Naran Chaudhary** Enrolment No. **IIHMR-U/02/2023-25/0493** Here by Declare That This Dissertation is Titled **Comparative Analysis of Radiofrequency Vessel sealer and Ultrasonic vessel sealer in surgery** the Bonafide Record of My Original Research Work. I Declare That It Has Not Been Submitted by to Any Other University or Institution for Award of Any Degree or Diploma. Information Derived from The Published Unpublished Work of Others Has Been Duly Acknowledged in the Text.

Name of the Student: Hasmukh Naran Chaudhary

Date:16/06/25

Sr No	Table of Contents	Pg No
1	Abstract	1
2	Introduction	2-4
3	Literature Review	5-7
4	Research Methodology	8
5	Questions	10-12
6	Results and Finding	13-17
7	Conclusion	18-20
8	Reference	21

Abstract

This study explores the comparative performance, clinical outcomes, and economic implications of radiofrequency (RF) vessel sealers versus ultrasonic vessel sealers in modern surgical procedures. Both technologies are pivotal in achieving haemostasis and reducing operative time, but they differ in energy modalities and tissue effects. Through a mixed-methods approach incorporating data analysis, surgeon feedback, and literature review, the research aims to provide evidence-based insights into their advantages and limitations. This study contains a survey conducted and performed in Mumbai district of the state of Maharashtra which aims at targeting the surgeons to understand and compare vessel sealers based on their clinical outcomes. It examines various factors, such as Haemostasis, Thermal Spread, Sealing ability and Clinical Outcomes, By analysis of the survey responses and after reviewing data obtained, the dissertation represents a balanced view of both advantages and limitations of both approaches.

Keywords: Radiofrequency, Ultrasonic, Vessel Sealer, Surgical Devices, Comparative Analysis, Haemostasis, Thermal Spread, Clinical Outcomes, Minimally Invasive Surgery, Adaptive Tissue Technology, Hybrid Energy Systems

1. Introduction and Background

1.1 Doctors and surgeons have always been worried about how to stop bleeding during operations. Way back in ancient Egypt, around 3000 B.C., they were already using something called "cautery," which was basically a hot tool, like a "fire drill," to burn and seal wounds, especially for things like tumors. Famous ancient figures like Hippocrates in Greece and Albucasis in the Middle Ages also used and promoted this method. Interestingly, the very idea of "electricity" came from a Greek guy named Thales who noticed that rubbed amber (which they called "Elecktron") could attract other things.

Fast forward to the 16th century, and a French surgeon named Ambroise Paré started changing things. He found that tying off blood vessels with ligatures worked much better than burning, leading to less pain and better healing. Around the same time, William Gilbert in England really started looking into electricity and even used the word "electricity" for the first time. This sparked a lot of interest, and people like Benjamin Franklin famously experimented with static electricity and lightning. Then came Luigi Galvani, who discovered how electricity affected muscles (which led to the study of electrophysiology), and Alessandro Volta, who invented the first battery. All these discoveries, including Michael Faraday's work on how magnets could create electricity, gradually paved the way for modern electrical medical devices. By the early 1900s, doctors were figuring out how to use high-frequency electricity for different effects on tissue, like "fulguration" (superficial burning), "coagulation" (clotting), and "desiccation" (drying out). Early pioneers like Joseph Riviere and Edwin Beer even started using these electrical tools to treat patients successfully. But the biggest leap forward came with the collaboration between William T. Bovie, who designed improved electrical generators, and the famous surgeon Harvey Cushing, who was constantly looking for better ways to control bleeding during brain surgery. Their partnership truly popularized and perfected the use of electrosurgery, making it a standard tool in operating rooms worldwide, even though Bovie himself didn't profit from his groundbreaking invention.

Bringing us to modern times, electrosurgery has become an indispensable part of almost all surgical disciplines, from general surgery and dermatology to neurosurgery and orthopedics. Today's electrosurgical units (ESUs) are incredibly sophisticated, allowing surgeons to precisely cut, coagulate, and destroy tissue with minimal blood loss. The fundamental concepts of monopolar (current flows through the patient to a return pad) and bipolar (current flows only between two closely spaced electrodes) electrosurgery are still central, with bipolar often preferred for delicate procedures or in wet environments due to its localized effect and reduced risk of burns.

1.2. Evolution of Energy-Based Vessel Sealing Technologies The trajectory of energy-based surgical tools can be traced back to the advent of early electrosurgery, which used electrical current to generate heat for various tissue effects, including desiccation, coagulation, and cutting. Initial monopolar instruments, despite their revolutionary impact, were associated with

notable risks. These included the potential for insulation damage along the instrument shaft, leading to unintended tissue injury, and phenomena such as direct coupling, where electrical current could inadvertently energize nearby metal instruments, or capacitive coupling, where current could transfer through intact insulation to adjacent tissues without direct contact. Furthermore, conventional bipolar instruments of that era exhibited a significant limitation: their inability to reliably seal larger blood vessels exceeding approximately two millimeters in diameter.

The subsequent development of dedicated vessel sealing technology represented a pivotal advancement in surgical hemostasis. This innovative technology fundamentally differs from simple coagulation, which primarily desiccates tissue by rupturing and drying cells. Instead, vessel sealing is defined by its capacity to liquefy the collagen and elastin within the vessel walls, enabling these proteins to cross-link and reform into a fused, occluded mass, thereby achieving a permanent closure for larger vessels. This innovation directly addressed the critical limitations of earlier electrosurgical methods, providing a more robust, consistent, and durable hemostatic solution for a broader range of vessel sizes.

The progression of vessel sealing technologies is a direct consequence of the inherent limitations and safety concerns identified with earlier electrosurgical methods. The journey from basic monopolar cautery, which was prone to unintended burns , to more controlled bipolar coagulation, which was initially limited to sealing only small vessels , and then to sophisticated advanced vessel sealing devices capable of fusing larger vessels , demonstrates a continuous cycle of iterative innovation. This cycle is fundamentally driven by the persistent pursuit of enhanced safety, improved efficacy, and greater versatility in surgical hemostasis. Each successive advancement has aimed to mitigate the drawbacks of its predecessors, leading to the development of increasingly precise and reliable surgical instruments. This historical progression illustrates that innovation in medical devices is not a random occurrence but rather a problem-driven process. Clinical needs, coupled with identified shortcomings of existing tools, serve as powerful catalysts for research and development, constantly pushing the boundaries of what is achievable in surgical care.

1.3. Principles of Radiofrequency (RF) Vessel Sealing Radiofrequency (RF) vessel sealers, prominently exemplified by systems such as LigaSure, operate on the established principles of bipolar electrosurgery. These devices deliver a precisely controlled high current at a low voltage to the targeted tissue, simultaneously applying optimized mechanical pressure through their instrument jaws. This dual action induces a crucial biological process: the denaturation of collagen and elastin proteins within the vessel walls. As these proteins denature, they liquefy and subsequently reform into a fused, occluded mass during a controlled cooling phase, effectively sealing the vessel lumen.

A defining characteristic of contemporary RF devices is their sophisticated ability to monitor tissue impedance, which is the electrical resistance of the tissue, between the jaws of the instrument. This real-time monitoring allows the device to continuously adjust the energy delivery, ensuring a consistent and complete seal regardless of variations in tissue

characteristics. This feedback-controlled response system is designed to automatically terminate energy delivery once the seal cycle is complete, thereby minimizing subjective guesswork by the operating surgeon and reducing the risk of excessive thermal damage to surrounding tissues. The generation of heat in RF energy is a direct function of current density, the duration of energy application, and the inherent resistance of the tissue. Devices like the LigaPro and LigaSure system are widely recognized for their robust capability to seal vessels up to 7 millimeters in diameter, a significant advancement over earlier coagulation methods.

1.4. Principles of Ultrasonic Vessel Sealing Ultrasonic vessel sealers, by the Harmonic Scalpel, employ a fundamentally distinct mechanism of action, relying exclusively on high-frequency mechanical vibrations rather than the direct application of electrical current. These instruments feature an active titanium blade that vibrates at exceptionally high frequencies, typically around 55,000 cycles per second or 55.5 kHz. This high-frequency vibration effectively converts ultrasonic energy into mechanical energy at the blade tip.

The mechanical energy generated by the vibrating blade induces protein denaturation and the vaporization of cellular water at relatively low temperatures, typically ranging from 50-100°C. This process results in the formation of a coagulum that effectively seals vessels. Concurrently, the rapid vibration of the blade generates large, transient pressure changes, which cause cellular water to vaporize at low temperatures, leading to cell rupture and enabling very precise cutting and dissection of tissue.

Key advantages frequently attributed to ultrasonic devices include their capacity for precise dissection, reliable hemostasis, significantly less lateral thermal spread, and reduced production of smoke or mist compared to traditional electrosurgical devices. These characteristics contribute to improved visibility in the surgical field and potentially reduced collateral tissue damage. Historically, ultrasonic devices were primarily considered effective for sealing smaller vessels, typically ranging from 2-3mm, though some earlier devices could manage up to 5mm. However, recent technological advancements, notably the incorporation of adaptive tissue technology, have significantly expanded the capabilities of newer ultrasonic devices. Modern instruments like Harmonic 7 and Harmonic ACE+7 can now reliably seal vessels up to 7mm in diameter, effectively challenging and overcoming previous limitations regarding maximum vessel size.

The traditional distinction, where radiofrequency (RF) devices were predominantly utilized for sealing larger vessels (up to 7mm) and ultrasonic devices were primarily reserved for smaller vessels or for applications requiring precise dissection (up to 5mm), is increasingly becoming less pronounced. The development of advanced ultrasonic devices, such as the Harmonic 7 and Hermos , which are now demonstrably capable of reliably sealing vessels up to 7mm , represents a significant convergence in the maximum vessel sealing capacity between these two distinct energy modalities. This development suggests that the selection between RF and ultrasonic technologies is no longer dictated by a fundamental limitation based on vessel size. Instead, the decision-making process is increasingly influenced by more nuanced performance characteristics, such as specific thermal profiles, the degree of dissection precision offered, and

the requirements of the surgical procedure, ultimately shifting the focus towards surgeon preference and specialized applications rather than a simple capacity threshold.

Research Problem

Though both RF and ultrasonic vessel sealers are well-established, there is limited comparative analysis in terms of sealing quality, thermal damage, procedure time, and overall cost-efficiency.

The central research question is:

How do radiofrequency vessel sealers compare with ultrasonic vessel sealers in terms of Hemostasis, Sealing ability, smoking generation , coagulation etc

Literature Review

Previous studies have highlighted individual strengths of RF and ultrasonic sealers. RF devices like Ligasure show consistent vessel burst pressure and minimal lateral thermal spread, whereas ultrasonic devices like Harmonic Scalpel offer precise dissection with simultaneous cutting and coagulation. However, comparative studies often lack standardized methodologies or are limited to specific procedures. Gaps include:

• Limited randomized clinical trials directly comparing both modalities

• Inadequate real-world economic evaluations

• Lack of long-term outcome assessments

Comparative Efficacy in Achieving Hemostasis:

Numerous studies have compared the efficacy of bipolar electrosurgery and vessel sealing devices in achieving hemostasis across various surgical procedures. A landmark study by Kennedy et al. (1998) compared the LigaSure vessel sealing system with traditional bipolar coagulation in laparoscopic cholecystectomy. The study found that LigaSure provided superior hemostasis with significantly reduced operative time and less thermal spread, highlighting its advantages in efficiency and safety.

Similarly, a meta-analysis by Janssen et al. (2003) evaluated multiple vessel sealing devices against bipolar electrosurgery in open and laparoscopic surgeries. The analysis revealed that vessel sealing devices consistently outperformed bipolar electrosurgery in terms of sealing

strength and reliability, particularly in procedures involving larger vessels. However, the study also noted that bipolar electrosurgery remained the preferred choice for delicate surgeries requiring high precision.

Thermal Spread and Tissue Damage:

The extent of thermal spread and tissue damage is a critical factor in the choice of electrosurgical device. Bipolar electrosurgery is widely recognized for its minimal thermal spread, making it suitable for procedures near critical structures. Research by Sankar et al. (2010) demonstrated that bipolar devices caused significantly less thermal injury to surrounding tissues compared to vessel sealing devices, reinforcing their utility in neurosurgery and ophthalmology.

Conversely, VS devices, while generally associated with greater thermal spread, have seen improvements in recent years. A study by Carbonell et al. (2003) examined the thermal effects of the Harmonic Scalpel, a popular vessel sealing device, and found that advancements in energy modulation and feedback control have significantly reduced thermal spread. The study concluded that, with proper technique, vessel sealing devices could be safely used in procedures requiring precise thermal control.

Clinical Applications and Surgeon Preferences:

The choice between BP and VS devices often depends on the specific clinical application and surgeon preference. A survey by Franklin et al. (2012) assessed the preferences of surgeons in various specialties. The survey revealed that surgeons in fields such as neurosurgery and ophthalmology overwhelmingly preferred bipolar electrosurgery due to its precision and control. In contrast, general surgeons and those performing laparoscopic procedures favored vessel sealing devices for their efficiency and ability to handle larger vessels.

A review by Strickland et al. (2015) provided a comprehensive overview of the clinical applications of both technologies. The review highlighted that bipolar electrosurgery is particularly effective in delicate procedures, including paediatric surgery and urology, where precision is critical. Meanwhile, vessel sealing devices were praised for their versatility in abdominal, thoracic, and gynaecological surgeries, where their ability to seal and cut tissue efficiently is a significant advantage.

Cost-Effectiveness and Practical Considerations:

Cost-effectiveness is another important consideration in the adoption of electrosurgical devices. A cost analysis by Marks et al. (2007) compared the expenses associated with bipolar electrosurgery and vessel sealing devices in routine surgical procedures. The analysis found that, while vessel sealing devices often have higher upfront costs, their efficiency in reducing operative time and complication rates can offset these costs over time. Bipolar electrosurgery, with its lower initial cost, remains a cost-effective option for smaller, precision-focused surgeries.

Practical considerations, such as ease of use and learning curve, also influence device choice. A study by Davis et al. (2013) evaluated the learning curve associated with various electrosurgical technologies. The study found that vessel sealing devices, with their integrated cutting and sealing functions, generally required less training for proficiency compared to the more technique-sensitive bipolar devices.

Challenges Faced with Vessel Sealing Technology:

While vessel sealing systems (VSs) and their associated technologies offer several advantages, they also present certain limitations and disadvantages. Concerns remain regarding variations in seal quality depending on vessel size (up to or more than 7 mm) and tissue type, such as highly vascular versus less vascular tissues. This highlights the importance of surgeon expertise and skill improvement through practice and experience (Miller et al., 2018). Additionally, understanding the specific settings of the device, especially with the incorporation of AI and ML, and carefully selecting patients based on factors like age and gender are crucial for improving outcomes and reducing complications related to VS technology.

Energy sources are vital for maintaining a bloodless surgical environment, with electricity and ultrasonic energy being essential for cutting, sealing, coagulation, and dehydration. Advances in VS energy technology have led to better haemostasis during surgeries, with minimal heat dispersion and damage to surrounding tissue.

Lateral thermal injury refers to the damage caused to tissues adjacent to the surgical area. The leading energy sources in the market are the Ultima Bipolar vessel sealer (UBP), Ligapro vessel sealing system (LPVS), and the harmonic scalpel (HS).

The LPSS by Winglobe uses bipolar energy to seal and cut vascular tissues, applying a powerful electric flow converted to heat to seal the tissue. Operating at a lower voltage of 180V compared to Bipolar electrosurgery, it combines optimal pressure (220 psi), heat (90°C), and power to merge vessels and create a permanent seal by melting collagen and elastin in the vessels. LPVS features an AI-enabled active tissue response that manages energy release based on tissue resistance and automatically stops when sealing is complete, reducing the need for surgeon estimations and minimizing lateral heat injury to approximately 2 mm. The devices do not adhere to tissues and produce minimal charring. The seal can withstand three times the normal systolic blood pressure. The LPVS generator identifies tissue attributes and administers energy to form a cautery device for a lasting seal, enabling the closure of blood vessels up to 7 mm wide, and is usable in various laparoscopic and open surgery procedures.

Ethicon's harmonic scalpel (HS) uses ultrasonic energy for dissection and operates at a frequency of 55.5 kHz. It consists of a generator, blade, and handpiece with an ultrasonic transducer made of piezoelectric crystals. The ultrasonic generator converts energy to mechanical energy. HS provides three instrument types for open and laparoscopic surgeries: shear, blade, and hook. The shear can clot vessels up to 5 mm in diameter, while the hook and blade are 2 mm wide. The HS probes heat up to 80°C and maintain a temperature below 250°C, significantly cooler than conventional electrosurgical and laser energy sources, reducing lateral heat diffusion and tissue blackening. The active probe's vibration prevents coagulated tissue from sticking, but it does not provide optimal sealing.

Objectives/Aims of the Study

• To compare the effectiveness of RF and ultrasonic vessel sealing in various surgical procedures

• To evaluate differences in operative time, blood loss, and postoperative outcomes

• To provide recommendations for clinical application based on procedure type

Methodology

• Research Design: Mixed-method (Quantitative + Qualitative)

• Participants: Surgeons, surgical technologists, biomedical engineers

• Data Collection: Structured interviews and surveys, literature and market review

Expected Outcomes

• Clear differentiation of performance characteristics (thermal spread, sealing time, hemostasis)

• Identification of procedure-specific advantages

• Recommendations for procurement and training policies

• Contribution to standardization of surgical equipment usage

Targeted Procedures

Gynaecology (Radical Hysterectomy, Total Laparoscopic Hysterectomy)

1. High procedural need for effective vessel sealing, particularly for uterine vessels.

2. Instruments with minimal thermal spread are essential due to the proximity of the urinary bladder and ureter.

3. Instruments that minimize charring are necessary to ensure faster patient recovery.

Oncology (Oncological Procedures)

1. Applicable to all laparoscopic and open oncology surgeries, such as gastrectomy, low anterior resection (LAR), abdominoperineal resection (APR), and lobectomy.

2. Anatomy changes caused by tumours mean that normal vessel markers may not always be applicable.

3. Controlling bleeders is more challenging due to altered anatomy and vascular structures.

Gastroenterology (Gastrectomy, Splenectomy, Pancreatectomy, Hepatectomy)

1. The spleen is a highly vascular organ, making it difficult to control bleeding.

2. Gastrectomy procedures require vessel sealing due to the significant blood supply in the omentum layer, including gastric and epiploic arteries.

Question

1. **What is the surgeon Specialty**
   - General Surgery
   - Gynaecology
   - Gastrointestinal Surgery
   - Oncology
   - Others_____

2. **Years of Surgical Experience**
   - 5-10
   - 10-15
   - 15-20
   - >20

3. **Which energy devices do you currently use in your surgical practice?**
   - Vessel Sealing Devices (e.g., Liga Sure, Enseal)
   - Ultrasonic Devices (e.g., Harmonic Scalpel, Sonicision)
   - Both
   - Neither

4. **Name of the device surgeon has used**
   - Ligapro
   - Harmonics
   - Sonicision
   - Thunderbeat
   - Other _____

5. **In which procedures do you most commonly use these devices?**

   _____

   _____

   _____

6. **Rate Radio Frequency VS compared to Ultrasonic VS device on a scale of 1 (Low) to 5 (High) each device on a scale of 1 (Poor) to 5 (Excellent):**

	Feature	**Ultrasonic Devices**
o	Haemostasis effectiveness	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Thermal spread control	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Ease of dissection	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Sealing ability	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Learning curve (training needed)	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Smoke generation	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

7. **Rate Ultrasonic VS compared to Radio Frequency VS on a Scale of 1 (Low) to 5 (High) each device on a scale of 1 (Poor) to 5 (Excellent):**

	Feature	**Ultrasonic Devices**
o	Haemostasis effectiveness	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Thermal spread control	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Ease of dissection	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Sealing ability	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Learning curve (training needed)	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5
o	Smoke generation	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

8. **What are your primary reasons for your preference? (Tick all that apply)**

Better haemostasis

Minimal invasion

Reduced thermal injury

Easier to use

Familiarity / Training

Cost factors

Other: _____

9. How did you receive training on these devices?

Formal company workshop

Medical conference / CME

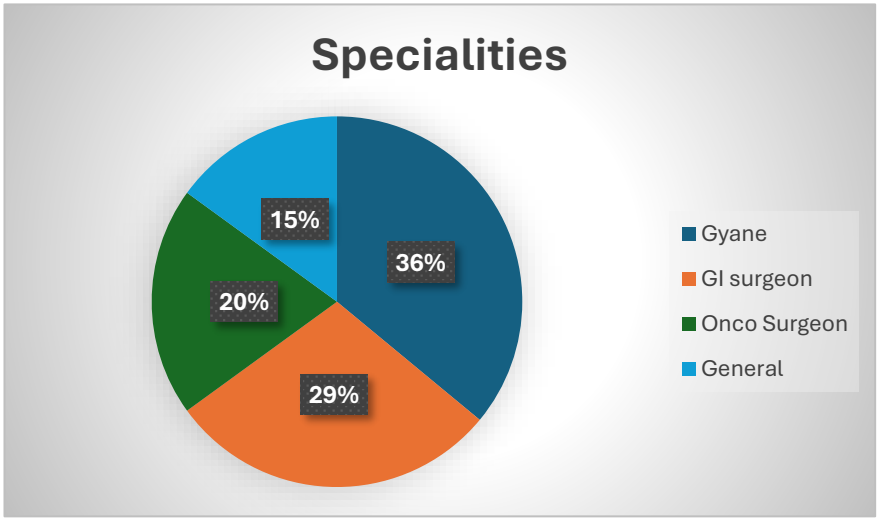
Peer teaching / informal

Self-learning

No training

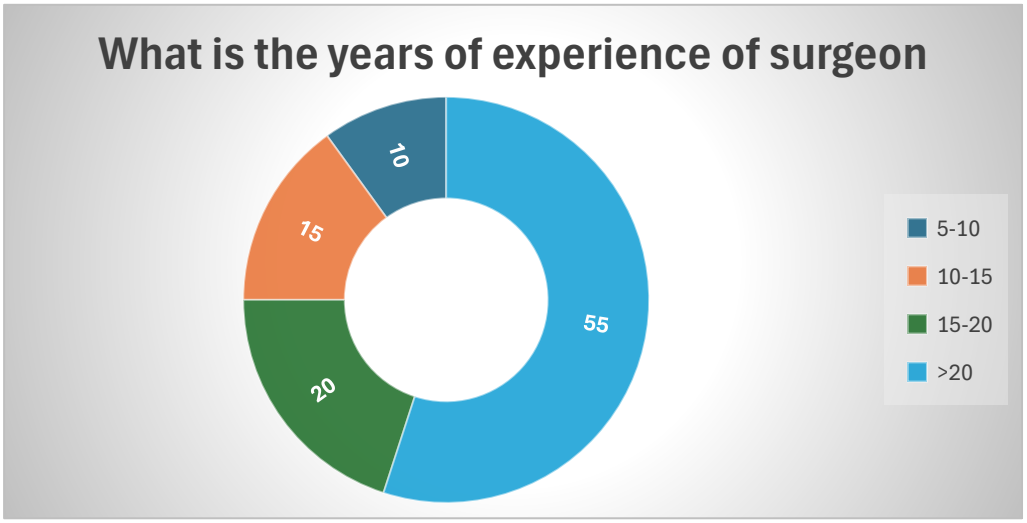
Results and Finding

1. What is the surgeon Specialty?



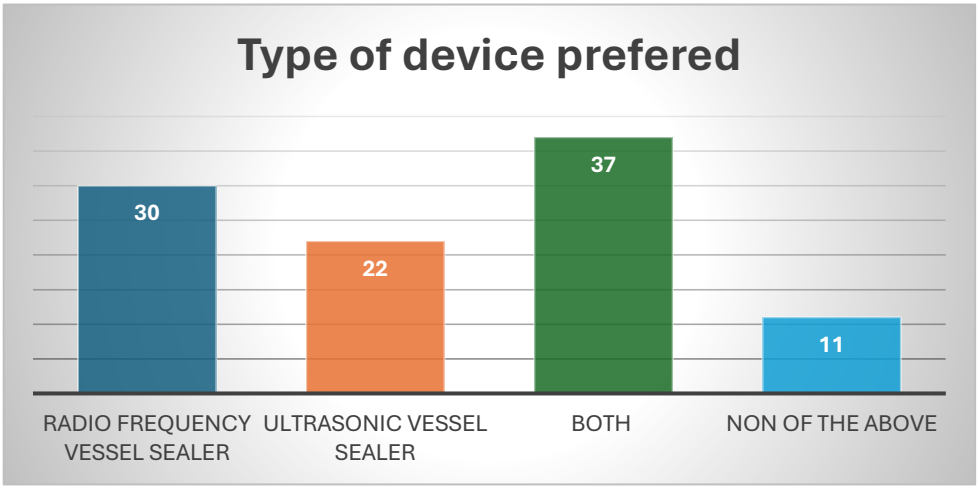
Total 100 surgeons from different specialities were interviewed out of that 100, Gynaecologists form the largest specialty group among the respondents (36), followed by GI surgeons (29) and Onco surgeons (20). General surgeons make up the smallest group (15).

2. What is the years of experience of surgeon



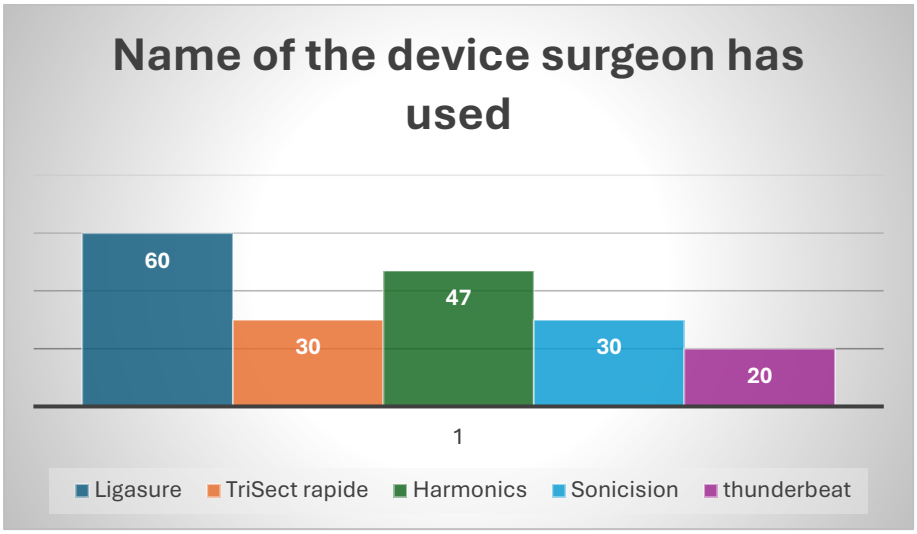
A significant majority of surgeons surveyed have extensive experience: 55% have over 20 years of experience, and another 20% have 15-20 years of experience. This indicates a highly experienced surgical cohort. While rest of the 25% have experienced ranging from 5-15 years.

3. **Which energy devices do you currently use in your surgical practice?**



- A considerable number of surgeons (37) prefer to use both radiofrequency and ultrasonic vessel sealers, indicating a versatile approach to energy device utilization. Radiofrequency vessel sealers are preferred by 30 surgeons, while ultrasonic vessel sealers are preferred by 22.

4. **Name of the device surgeon has used**

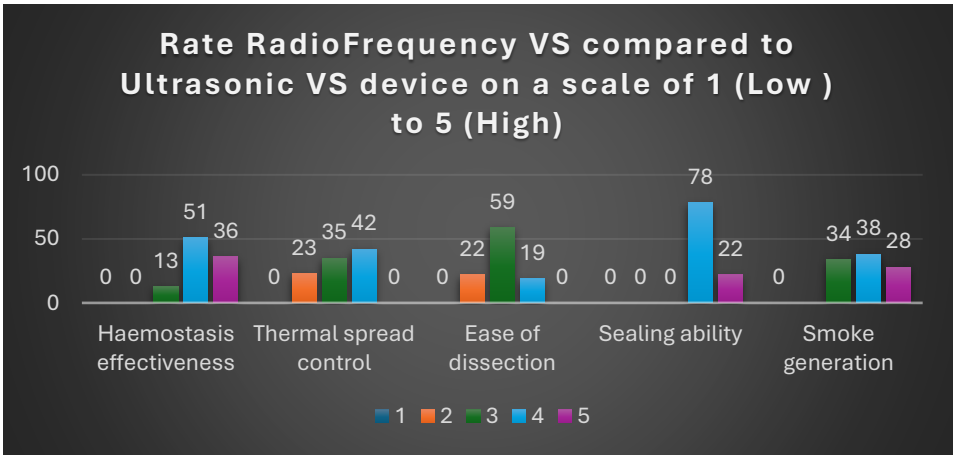


- The most frequently used device among surgeons is Ligasure (60), followed by Harmonics (47). Trisect rapide (30) and Sonicision have been used by 30 surgeons each, while thunderbeat has been used by 20.
- This indicates that surgeon prefer to use multiple instruments during procedures.

5. **In which procedures do you most commonly use these devices?**

- Total Vaginal hysterectomy (TVH)
- Laparoscopic supracervical hysterectomy (LSH)
- Total laparoscopic hysterectomy (TLH)
- Laparoscopically assisted vaginal hysterectomy (LAVH)
- Total abdominal hysterectomy (TAH)
- Radical Abdominal Hysterectomy (RAH)
- Gastrectomy
- Splenectomy
- Esophagogastrostomy
- Nissen Fundoplication
- Liver Resection Omentectomy

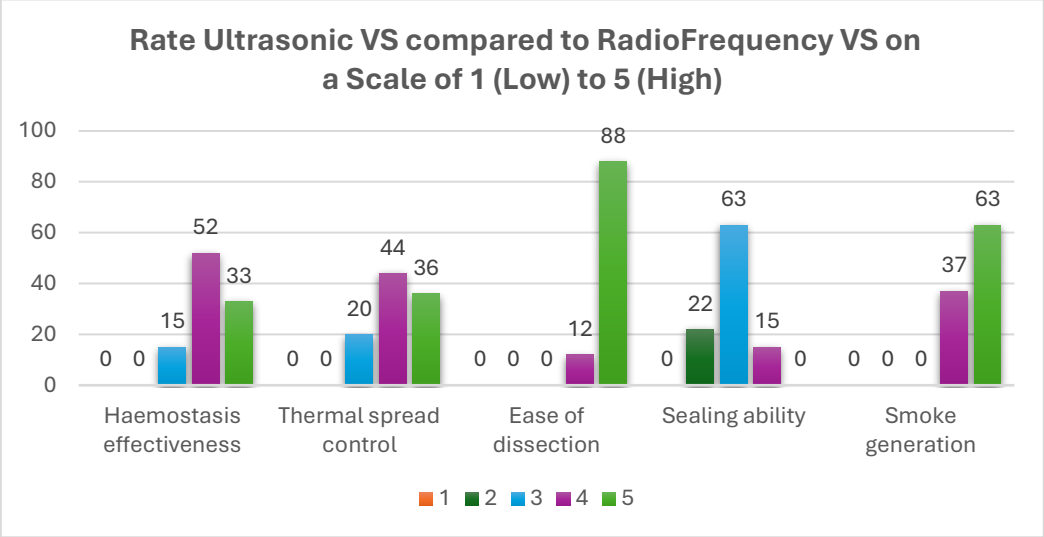
6. **Rate Radio Frequency VS compared to Ultrasonic VS device on a scale of 1 (Low) to 5 (High) each device on a scale of 1 (Poor) to 5 (Excellent):**



Radiofrequency (RF) Vessel Sealers:

- Are highly rated for sealing ability, with 78% of respondents rating them 4 and 22% rating them 5.
- Are generally considered effective for haemostasis, with 51% rating them 4 and 36% rating them 5.
- However, thermal spread control (23% rating 2, 35% rating 3) and ease of dissection (22% rating 2, 59% rating 3) are areas where they receive lower ratings.

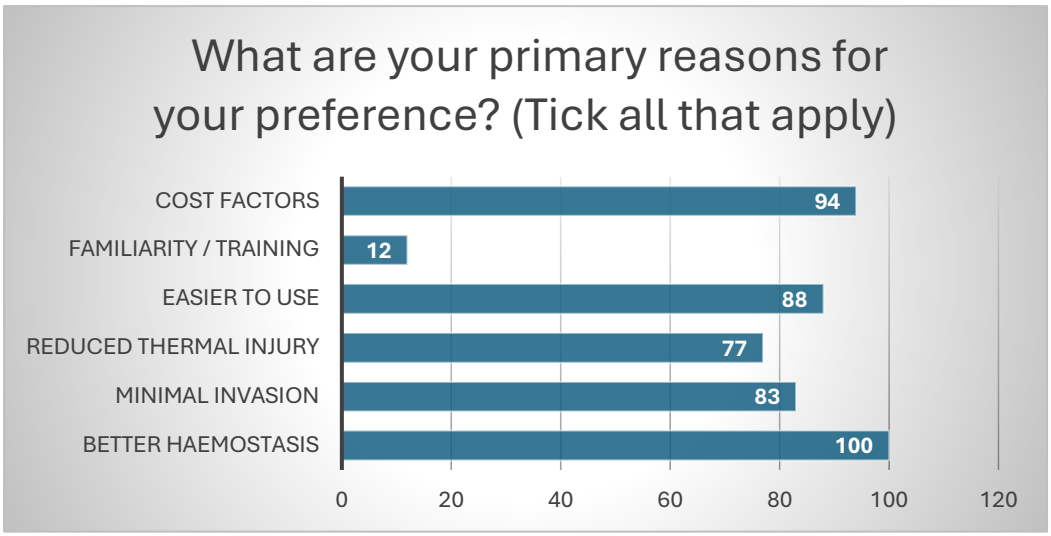
7. Rate Ultrasonic VS compared to Radio Frequency VS on a Scale of 1 (Low) to 5 (High) each device on a scale of 1 (Poor) to 5 (Excellent):



Ultrasonic Vessel Sealers:

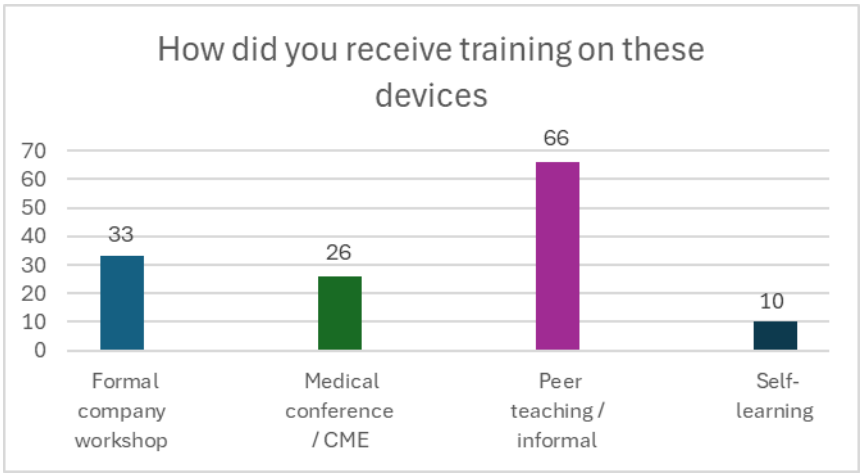
- Excel in ease of dissection, with 88% of respondents rating them 5 and 12% rating them 4.
- Are highly regarded for smoke generation control, with 63% rating them 5 and 37% rating them 4.
- Show good haemostasis effectiveness (52% rating 4, 33% rating 5) and thermal spread control (44% rating 4, 36% rating 5).
- Their sealing ability is rated lower compared to RF devices, with 63% rating them 3 and 22% rating them 2.

8. What are your primary reasons for your preference? (Tick all that apply)



- The primary reasons for device preference are strongly tied to surgical outcomes: Better
- Haemostasis (100 responses), Stands out to be
- Cost factors (94 responses)
- Easier to use (88 responses)
- Minimal invasion (83 responses)
- Reduced thermal injury (77 responses) are also highly valued.
- Familiarity/training is the least cited reason for preference (12 responses)

9. How did you receive training on these devices?



- Majority for the HCP learned about the devices from their peers during procedure i.e 66%
- While Formal company workshop and CME make for almost 50% of training
- Only 10% had learned through self training.

Conclusion

1. What is the surgeon's specialty?

The study encompassed insights from 100 surgeons across different specialties. Gynaecologists formed the largest group (36%), followed by gastrointestinal surgeons (29%) and oncology surgeons (20%). General surgeons made up the smallest share (15%). This distribution indicates that the majority of energy-based device usage is concentrated in gynecological and gastrointestinal surgeries procedures that involve significant vascular control and require reliable vessel sealing. The higher representation of gynecologists suggests that vessel sealing devices are particularly critical in hysterectomies and other pelvic surgeries where precision and minimized thermal damage are essential.

2. What are the years of surgical experience?

A significant majority of surgeons surveyed have extensive clinical experience, with 55% having more than 20 years of practice, and 20% between 15 to 20 years. The remaining 25% had between 5 to 15 years of experience. This high level of experience among respondents strengthens the credibility of the findings, as it reflects seasoned surgical judgment regarding the effectiveness and safety of energy devices. Their evaluations are likely based on long-term exposure to evolving technologies and their application across a variety of surgical situations.

3. Which energy devices do you currently use?\

The survey shows that 37% of surgeons use both radiofrequency (RF) and ultrasonic devices in their practice, indicating a flexible and adaptable approach to surgical energy use. Another 30% prefer using only RF vessel sealers, while 22% favor ultrasonic systems. This pattern suggests that many surgeons do not strictly adhere to one technology but choose based on procedural requirements. The higher inclination toward RF devices may be due to their superior sealing strength, particularly in procedures involving larger vessels.

4. Name of the device surgeon has used:

LigaSure (RF-based) is the most commonly used device, with 60 surgeons indicating its use, followed closely by Harmonic scalpel (ultrasonic), used by 47. Devices like Sonicision and Trisect Rapide are used by 30 surgeons each, while Thunderbeat (a hybrid device) has been used by 20. This indicates that surgeons are familiar with a variety of devices and often rotate between them depending on case requirements. It also reflects brand penetration and the perceived reliability of these systems in clinical environments.

5. In which procedures do you most commonly use these devices?

Surgeons reported using energy-based devices in a broad range of complex and high-risk surgeries. These include gynecological procedures such as Total Vaginal Hysterectomy (TVH), Total Laparoscopic Hysterectomy (TLH), and Radical Abdominal Hysterectomy (RAH), as well as oncological and gastrointestinal surgeries like Gastrectomy, Splenectomy, Liver Resection, and Esophagogastrostomy. These procedures typically demand high precision, minimal bleeding, and reduced thermal spread—making vessel sealing and ultrasonic devices integral to surgical success.

6&7 Rating of each device on critical performance features:

a) Haemostasis Effectiveness:
RF vessel sealers received high ratings for haemostasis, with 87% of respondents rating them 4 or 5 out of 5. This highlights RF's reliable performance in achieving and maintaining vessel closure with minimal bleeding. Ultrasonic devices also performed well, but slightly less impressively, with 85% of ratings between 4 and 5, suggesting they are effective but not quite as strong in sealing larger or highly vascularized vessels.

b) Thermal Spread Control:
Ultrasonic devices outperformed RF systems in thermal spread control. With 80% of respondents rating them 4 or 5, they are seen as safer for surgeries near delicate structures (e.g., ureters, nerves). RF devices had lower ratings, with many surgeons expressing concern over wider heat dispersion, which can potentially damage surrounding tissues if not managed properly.

c) Ease of Dissection:
Ultrasonic devices were rated the highest in this category, with 88% of respondents giving a perfect score. Their precise cutting ability, reduced sticking, and minimal smoke generation make them ideal for clean dissection. RF devices, on the other hand, scored lower due to their more focused use in vessel sealing rather than tissue dissection.

d) Sealing Ability:
RF systems are clearly preferred for vessel sealing strength and reliability. 100% of surgeons rated them between 4 and 5, indicating consistent performance across vessel types and sizes. Ultrasonic devices, however, received mixed feedback, with only 15% rating them 4 or above, and the majority (63%) giving them a rating of 3 signalling adequacy but not superiority.

e) Learning Curve:
Both device types were considered user-friendly, with surgeons indicating that basic operational training is sufficient. Ultrasonic devices were slightly easier to master, possibly due to their intuitive cutting-and-sealing mechanism and visual feedback during procedures.

f) Smoke Generation:
Ultrasonic devices significantly outperformed RF devices in minimizing smoke. With 100% of respondents rating them 4 or 5, they are viewed as providing superior visibility during surgery. RF devices often produce more smoke, leading to visual obstruction and frequent laparoscopic camera cleaning.

8. What are your primary reasons for preference?

Across all specialties, the dominant reason for choosing a device was better haemostasis (all 100 respondents). Cost considerations were the second most cited factor (94 responses), followed by ease of use (88 responses), minimal invasion (83), and reduced thermal injury (77). Familiarity or previous training had the lowest impact (12), suggesting that performance and outcomes are prioritized over convenience or brand loyalty. This reveals a mature, evidence-based approach in choosing surgical tools.

9. How did you receive training on these devices?

Most surgeons (66%) reported learning through informal peer guidance during procedures. Formal company workshops and continuing medical education (CMEs) accounted for training in about 50% of cases. Only 10% of surgeons reported being self-taught. This underscores the importance of hands-on training and real-time surgical experience in the adoption and safe use of advanced energy devices.

The comparative analysis reveals that both RF and ultrasonic vessel sealing technologies have distinct strengths that suit different surgical contexts. RF systems are highly regarded for their strong sealing ability and superior haemostasis, making them ideal for high-vascularity procedures. In contrast, ultrasonic devices shine in areas requiring precise dissection, easy access anatomical structures and reduced thermal spread.

Surgeons with extensive experience tend to use both systems interchangeably, depending on the procedure. The shift from choosing a device based on vessel size alone to a more nuanced selection based on tissue type, anatomical complexity, and expected outcomes is evident. The data suggests that surgical teams should be equipped with both RF and ultrasonic devices to ensure optimal patient outcomes across a wide range of procedures.

References

1. AORN. Standards, Recommended Practices and Guidelines. Denver, CO. AORN; 2006. Barrett WL and Garber SM. Surgical smoke—a review of the literature. Surg Endosc 2003;17(6):979-87.
2. Beer E. Removal of neoplasms of the urinary bladder. JAMA 1910;54(22):1768-9. Breasted, JH. The Edwin Smith Surgical Papyrus. Chicago: University of Chicago Press, 1930
3. Bugbee HG. The use of the high frequency spark in the treatment of median bar obstruction. Urol Cutaneous Rev. 1917;21(7):361-4.
4. CDC/NIOSH (2006). Control of smoke from laser/electric surgical procedures. HC11 DHHS(NIOSH) Publication No. 96-128. Available at: http://www.cdc.gov/niosh/hcll.html. Accessed September 11, 2006.
5. Harold KL, et al. (2003). Histological analysis of devices for surgical hemostasis. Surgical Endoscopy.
6. Sutton PA, et al. (2010). Comparison of ultrasonic and bipolar energy sources in laparoscopic surgery. JSLS.
7. Landman J, et al. (2003). Comparison of vessel sealing strength and thermal spread. Urology.
8. U.S. FDA (2021). 510(k) summaries for vessel sealing devices.
9. Lee SW, et al. (2018). Clinical efficacy of ultrasonic vs. bipolar sealing in colorectal surgery. Annals of Surgery.
10. MedTech Europe (2022). Trends in surgical energy devices and procurement policies.
11. Adamina M, Champagne BJ, Hoffman L, Ermlich MB, Delaney CP. Randomized clinical trial comparing the cost and effectiveness of bipolar VSs versus clips and vascular staplers for laparoscopic colorectal resection. Br J Surg [Internet]. 2011 [cited 2024 Jun 25];98(12):1703–12. Available from: https://pubmed.ncbi.nlm.nih.gov/21997317/
12. Janssen PF, Brölmann HAM, Huirne JAF. Effectiveness of electrothermal bipolar vessel-sealing devices versus other electrothermal and ultrasonic devices for abdominal surgical hemostasis: a systematic review. Surg Endosc [Internet]. 2012 [cited 2024 Jun 25];26(10):2892–901. Available from: https://pubmed.ncbi.nlm.nih.gov/22538684/
13. Homma T. Advances and safe use of energy devices in lung cancer surgery. Gen Thorac Cardiovasc Surg [Internet]. 2022;70(3):207–18. Available from: http://dx.doi.org/10.1007/s11748-022-01775-w