

Detection of Sentinel Lymph Nodes with Near-Infrared Imaging in Cervical and Endometrial Cancer Surgery

Ki Eun Seon, MD, Sang Wun Kim, MD, PhD

Institute of Women's Life Medical Science, the Division of Gynecologic Oncology, Department of Obstetrics and Gynecology, Yonsei University College of Medicine, Seoul, Republic of Korea

Cervical and endometrial cancers are significant gynecologic malignancies, being the fourth and sixth most prevalent cancers in women in 2020, respectively. Gynecologic cancer staging, especially lymph node (LN) metastasis evaluation, profoundly affects patient treatment and prognosis. Although various modalities, including computed tomography, magnetic resonance imaging, and ^{18}F -fluoro-2-deoxy-D-glucose positron emission tomography are available for LN metastasis assessment, their diagnostic accuracy is often insufficient, necessitating surgical LN evaluations. Traditional comprehensive lymph node dissection, once the standard, has now been replaced by sentinel lymph node (SLN) biopsy to minimize complications while maintaining accurate nodal staging. This review underscores the importance of near-infrared (NIR) imaging with indocyanine green (ICG) as an advanced method for SLN detection. NIR imaging, owing to its deep tissue penetration capabilities combined with ICG's unique properties, is comparable to former tracers for detecting SLNs, with minimal side effects and high diagnostic accuracy. Although challenges, such as difficulties in surgical skills and relatively high equipment costs, remain, this technique holds promise, demonstrating high detection rates and decreased morbidity, especially in early-stage cervical and endometrial cancers. This comprehensive review reinforces the growing relevance of NIR imaging with ICG in improving the diagnostic accuracy of SLN detection in gynecological cancers, thereby enhancing clinical decision-making and patient outcomes.

Key Words: Operative Surgical Procedure • Sentinel Lymph Node Biopsy

INTRODUCTION

Cancers arising in the uterus can be classified as cervical or endometrial. In 2020, cervical cancer was ranked as the fourth most common cancer and fourth leading cause of cancer-related deaths among women, accounting for approximately 604,000 new diagnoses and 342,000 fatalities worldwide. By contrast, endometrial cancer was the sixth most frequent cancer in women

that year, leading to approximately 417,000 new cases and 97,000 deaths[1]. The staging of gynecological cancers originating in the uterus, including the assessment of lymph node (LN) metastasis, significantly influences subsequent patient treatment and prognosis[2]. Therefore, in addition to the clinical stage, determined by radiologic evaluation and other clinical findings, and surgical staging, defined by pathological findings from surgical procedures, evaluation of LN metastasis is crucial[3,4]. LN evaluation methods have evolved from earlier practices of comprehensive lymphadenectomy to current techniques utilizing near-infrared (NIR) imaging for sentinel lymph node (SLN) biopsy. In this review, we aimed to delve into SLN detection using NIR imaging. To this end, we queried PubMed and Google Scholar for novel works published up to September 2023.

► Received: October 9, 2023, ► Accepted: October 31, 2023

Address for correspondence: **Sang Wun Kim**, MD, PhD

Institute of Women's Life Medical Science, the Division of Gynecologic Oncology, Department of Obstetrics and Gynecology, Yonsei University College of Medicine, Seoul, Korea, 50 Yonsei-ro Seodaemun-gu, Seoul 03722, Republic of Korea

Tel: +82-2-2228-2230, Fax: +82-2-313-8357

E-mail: san1@yuhs.ac

Main Body

1) SLN concept

The metastatic spreading patterns of cervical and endometrial cancers can involve hematogenous or lymphatic dissemination, direct contiguous extension, peritoneal seeding, or a combination of these mechanisms [5-7]. Among these, lymphatic spread leading to LN metastasis plays a crucial role in the prognosis. This is evident as patients with LN metastasis exhibit significantly lower survival rates than those without LN metastasis[8]. Various modalities, including computed tomography (CT), magnetic resonance imaging (MRI), ^{18}F -fluoro-2-deoxy-D-glucose positron emission tomography (^{18}F -FDG-PET), and lymphangiography, can be used to evaluate LN metastasis[9]. However, despite recent advancements in CT, MRI, and ^{18}F -FDG-PET, their diagnostic accuracies remain insufficient to replace surgical LN evaluation[10-12]. Thus, accurate staging through surgical LN evaluation is crucial for early stage cervical and endometrial cancers. Historically, comprehensive LN dissection (LND) has been performed for LN evaluation. However, recent findings have suggested that conventional LND does not offer a survival benefit in early-stage cervical or endometrial cancers[13,14]. Instead, it is associated with an extended operation duration and increased perioperative complications. Therefore, SLN has emerged as a strategy for minimizing these complications and providing accurate nodal staging.

SLN is typically the primary LN, to which malignant cells from a primary tumor are predisposed to metastasis. Since their initial implementation in the management of lower genitourinary tract malignancies, SLN biopsies have been recognized as the gold standard for melanoma and breast cancer management. Currently, SLN biopsy is included in therapeutic guidelines for vulvar, cervical, and endometrial cancers[15].

2) NIR imaging technology

(1) Other image techniques for SLN detection

The first use of a patent blue dye to visualize human

lymphatic vessels was reported in 1933, followed by the introduction of radiotracers for lymphatic drainage mapping in 1950, which enabled lymphoscintigraphy for edema and internal mammary LN visualization [16,17]. During the 1970s, investigators witnessed the advent of gamma cameras for radiotracer detection, and the intraoperative use of gamma-ray detection probes was first documented in 1984[18]. These advancements in imaging techniques have deepened our understanding of human lymphatics and furthered the SLN concept[19].

However, patent blue dye has limitations owing to its low detection rate and the necessity for visual confirmation. Radiotracers, such as technetium-99m radiocolloids, present challenges, including the cost of handling nuclear agents and medical staff exposure. Amid these limitations, the emergence of indocyanine green (ICG) in NIR imaging systems has shown comparable or higher detection rates than radiocolloids and blue dyes, accelerating advancements in the SLN detection field[20,21].

(2) NIR imaging technology with ICG

Appropriate tracers and surgical navigation systems are indispensable for implementing optical molecular imaging technology in clinical settings. NIR imaging systems stand out because of their unique characteristics. Specifically, NIR light operates within the tissue optical window wavelengths of 650-900 nm, offering significant penetration depth and minimal tissue absorption.

Additionally, owing to its low molecular weight, ICG may allow for rapid diffusion. Its minimal side effects and low toxicity, combined with its ability to bind albumin and metabolize swiftly in the liver for excretion, are notable advantages. ICG is a suitable fluorescent dye for NIR imaging systems with an absorption wavelength of 765 nm and an emission wavelength of 840 nm[22,23].

3) Clinical applications

Utilizing the NIR imaging system with the ICG tracer for SLN detection offers advantages over radiocolloids

with its low cost and infrastructure demands while enabling real-time intraoperative SLN detection. Moreover, it ensures a high degree of diagnostic accuracy for SLN identification, and minimizes surgical complications and risks[24].

However, employing an NIR imaging system for SLN detection requires a comprehensive anatomical understanding of lymphatics and a high level of proficiency in lymphatic channel tracing. This necessitates a learning curve for surgeons[25]. Although it is more cost-effective than radiocolloids, the NIR camera system is still equipped at a relatively high cost. Moreover, although rare, there are challenges related to allergic reactions to ICG compared with blue dye[26].

4) Comparative analysis

(1) Cervical cancer

Since the first report of SLN mapping in cervical cancer in 1999, numerous studies have been conducted [27]. In a randomized study comparing an SLN group and a group of patients with early cervical cancer undergoing SLN mapping along with validation of pelvic LND, the SLN group showed significantly decreased lymphatic morbidity without a difference in the 3-year recurrence-free survival (92.0% in the SLN group vs. 94.4% in the SLN+LND group)[13]. Currently, owing to its low morbidity and high detection rate, this method is included in the guidelines for LN evaluation during the surgical staging of early cervical cancer.

ICG was injected into the cervix for SLN detection preoperatively, regardless of the surgical method (laparotomy, laparoscopic, or robot-assisted), after general anesthesia. Typically, an ICG concentration suitable for mapping is 1.25 mg/mL, injected deep into the stroma and submucous at the 3 o'clock and 9 o'clock positions of the cervix with 1 cc each (Fig. 1)[28]. According to the SLN algorithm for early cervical cancer proposed by the Memorial Sloan Kettering Cancer Center in 2011, all mapped SLNs were excised, and any suspicious LNs were removed, regardless of mapping (Fig. 2). Moreover, if there is no mapping of the hemipelvis, performing a side-specific pelvic, common iliac, or in-

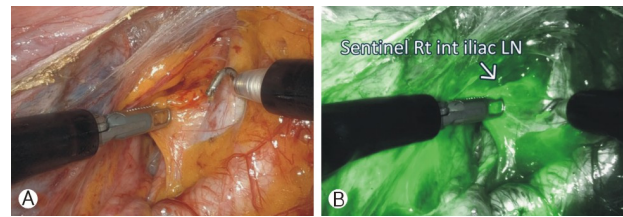


Fig. 1. Sentinel lymph node mapping in cervical cancer using indocyanine green as a fluorescent tracer. (A) Sentinel right internal iliac lymph node without near-infrared imaging. (B) With near-infrared imaging.

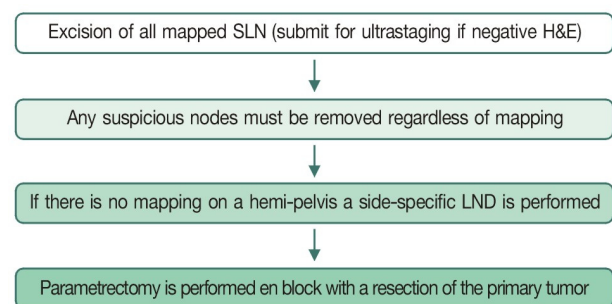


Fig. 2. Sentinel node mapping algorithm for cervical cancer. Abbreviation: sentinel lymph node; SLN, hematoxylin and eosin staining; H&E, lymphadenectomy; LND.

teriliac LND is recommended[29].

(2) Endometrial cancer

In gynecologic malignancies, after vulvar and cervical cancers, the concept of SLN has been introduced in endometrial cancer. Similar to cervical cancer, various studies have revealed that systemic pelvic LND in early endometrial cancer does not improve disease-free or overall survival, but increases surgical morbidity[30,31]. Consequently, attention has been drawn to the concept of SLN to avoid the negative impact on patient prognosis owing to the under-evaluation of an accurate stage and omission of adjuvant treatment resulting from omitting LN evaluation.

According to SENTI-ENDO, a prospective multi-center cohort study investigating the detection rate and diagnostic accuracy of SLN in early endometrial cancer, SLN biopsy could replace systemic LND[32]. Furthermore, a United States of America National Cancer Database study published in 2022 reported no significant difference in

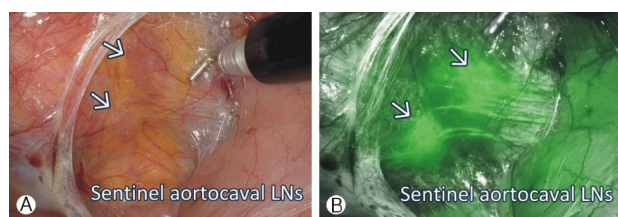


Fig. 3. Two-step sentinel lymph node mapping in endometrial cancer with indocyanine green (ICG) as a fluorescent tracer. This figure illustrates the 'first-step' in the two-step mapping technique. Following the injection of ICG into the bilateral uterine cornus at the subserosal myometrial layer, ICG drainage is visualized via the infundibulo-pelvic pathway. (A) Sentinel aortocaval lymph node captured without near-infrared imaging. (B) The same node visualized with near-infrared imaging.

overall survival between SLN biopsy and LND in patients with Stage I-III endometrial cancer[14].

Two tracer injection methods have been proposed for detecting SLNs in endometrial cancers. One approach is cervical injection, similar to that used for cervical cancers, and the other is fundal-site injection, either hysteroscopically or subserosally. While fundal-site injection shows a higher para-aortic LN detection rate, its technical difficulty makes it less favorable. By contrast, cervical injection is technically easier and offers relatively high and reproducible detection rates, making it the preferred technique for most surgeons[33]. Furthermore, a “two-step SLN mapping technique” has been proposed to enhance the detection rate of SLN in the para-aortic area[34,35]. This novel technique merges two previously discussed injection methods involving sequential injection of ICG into the uterine cornu and cervix, thereby enhancing the para-aortic SLN detection rate (Fig. 3). The first step of the “two-step SLN mapping technique” entails injecting 3 cc (1.25 mg/mL) of ICG into the bilateral uterine cornu in the subserosal myometrial layer (total, 6 cc) to detect para-aortic SLN. The subsequent step involves the injection of ICG at the 3 and 9 o'clock positions of the ectocervix, both superficially and deeply, with 1 cc per respective depth (total, 4 cc) to identify the pelvic SLN [36].

The “two-step SLN mapping technique” for endometrial cancer commences with a thorough exploration

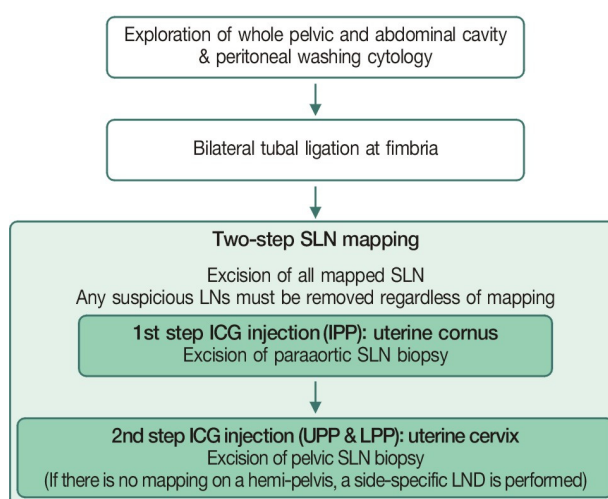


Fig. 4. Two-step sentinel node mapping algorithm for endometrial cancer.

Abbreviation: sentinel lymph node; SLN, infundibulo-pelvic pathway; IPP, upper paracervical pathway; UPP, lower paracervical pathway; LPP, lymphadenectomy; LND.

of the whole pelvic and abdominal cavities, subsequently accompanied by peritoneal washing cytology. To minimize the potential for tumor cell dissemination during uterine manipulation, bilateral tubal ligation was performed at the fimbria. This step protects against tumor spread and ensures that there is no inadvertent disruption to the lymphatic flow through the utero-ovarian ligament, especially if ligation is performed at the tube's isthmic portion. The first step involved a para-aortic SLN biopsy using bilateral cornual ICG injections. Subsequently, all detected SLNs were excised and any suspicious were removed, regardless of their mapping status. The second step involved ICG injection into the uterine cervix for pelvic SLN biopsy. If no LN mapping was identified in the hemipelvis, side-specific LND was performed (Fig. 4)[34,37].

5) Future perspectives of the NIR imaging system

Although there is limited evidence in the literature in the field of gynecological oncology, attempts have been made to detect SLNs in early ovarian cancer. Studies using Technetium-99m radiocolloid, as well as research employing ICG-NIR imaging system, are underway[38,39].

Furthermore, in the realm of benign gynecology, innovative approaches are explored for the evaluation of endometriotic lesions and the determination of resection margins. These strategies involve the administration of intravenous ICG injections and the subsequent utilization of ICG-NIR imaging systems for enhanced diagnostic and surgical precision[40,41].

Beyond its gynecological applications, the ICG-NIR imaging system is being utilized to assess bowel perfusion, highlighting its versatile potential across various clinical scenarios. With its expanding use across various fields, the ICG-NIR imaging system is expected to continually evolve and broaden its range of indications.

CONCLUSION

SLN detection in early stage gynecological cancers, specifically cervical and endometrial cancers, is of paramount importance for accurate staging and consequential therapeutic decision-making. This comprehensive review underscores the advancements in imaging modalities used for SLN detection, highlighting the potential of NIR imaging coupled with ICG as a tracer. The NIR imaging system, characterized by a substantial tissue penetration depth and minimal absorption, provides an efficient, cost-effective, and real-time approach for SLN detection. Despite the remarkable progress and advantages over traditional methods, the use of NIR imaging with ICG is not devoid of challenges. These include the difficulty of the surgical techniques and the acquisition cost of the NIR camera system.

In conclusion, the integration of NIR imaging technology with ICG for SLN detection in gynecological cancers presents a promising avenue for enhancing patient management by facilitating precise surgical staging and reducing associated complications. Ongoing research and clinical trials may address the existing challenges in ICG-NIR imaging technology, enhancing its precision and broadening its clinical applications. Such advancements are expected to improve the management and prognosis of gynecological and other cancers. The ongoing evolution of this technology may lead to more effective, efficient, and widely available solutions for

SLN detection and a variety of other clinical uses in the near future.

REFERENCE

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin* 2021;71:209-249.
2. Gardner AB, Charo LM, Mann AK, Kapp DS, Eskander RN, Chan JK. Ovarian, uterine, and cervical cancer patients with distant metastases at diagnosis: most common locations and outcomes. *Clin Exp Metastasis* 2020;37:107-113.
3. Berek JS, Matias-Guiu X, Creutzberg C, Fotopoulou C, Gaffney D, Kehoe S, et al. FIGO staging of endometrial cancer: 2023. *Int J Gynaecol Obstet* 2023;162:383-394.
4. Bhatla N, Berek JS, Cuello Fredes M, Denny LA, Grenman S, Karunaratne K, et al. Revised FIGO staging for carcinoma of the cervix uteri. *Int J Gynaecol Obstet* 2019;145:129-135.
5. Höckel M, Horn L-C, Tetsch E, Eibenkel J. Pattern analysis of regional spread and therapeutic lymph node dissection in cervical cancer based on ontogenetic anatomy. *Gynecol Oncol* 2012;125:168-174.
6. van den Tillaart SAHM, Trimbo JBMZ, Dreef EJ, Jordanova ES, Fleuren GJ. Patterns of Parametrial Involvement in Radical Hysterectomy Specimens of Cervical Cancer Patients. *Int J Gynecol Pathol* 2011;30:185-192.
7. Mariani A, Webb MJ, Keeney GL, Aletti G, Podratz KC. Endometrial cancer: predictors of peritoneal failure☆☆ Supported by the Mayo Cancer Center (P30CA15083) and the Rochester Research Committee, Mayo Foundation. Presented at the 33rd Annual Meeting of the Society of Gynecologic Oncologists, Miami Beach, FL, March 16 to 20, 2002. *Gynecol Oncol* 2003;89:236-242.
8. Manetta A, Delgado G, Petrilli E, Hummel S, Barnes W. The significance of paraaortic node status in carcinoma of the cervix and endometrium. *Gynecol Oncol* 1986;23:284-290.
9. Li H, Wu X, Cheng X. Advances in diagnosis and treatment of metastatic cervical cancer. *J Gynecol Oncol* 2016;27.
10. Kitajima K, Yamasaki E, Kaji Y, Murakami K, Sugimura K. Comparison of DWI and PET/CT in evaluation of lymph node metastasis in uterine cancer. *World J Radiol* 2012; 4:207-214.
11. Chung HH, Kang S-B, Cho JY, Kim JW, Park N-H, Song Y-S, et al. Can Preoperative MRI Accurately Evaluate Nodal and Parametrial Invasion in Early Stage Cervical Cancer? *Jpn J Clin Oncol* 2007;37:370-375.
12. Shen G, Zhou H, Jia Z, Deng H. Diagnostic performance of diffusion-weighted MRI for detection of pelvic metastatic

- lymph nodes in patients with cervical cancer: a systematic review and meta-analysis. *Br J Radiol* 2015;88:20150063.
13. Mathevet P, Lécure F, Uzan C, Boutitie F, Magaud L, Guyon F, et al. Sentinel lymph node biopsy and morbidity outcomes in early cervical cancer: Results of a multicentre randomised trial (SENTICOL-2). *Eur J Cancer* 2021;148:307-315.
14. Garzon S, Mariani A, Day CN, Habermann EB, Langstraat C, Glaser G, et al. Overall survival after surgical staging by lymph node dissection versus sentinel lymph node biopsy in endometrial cancer: a national cancer database study. *Int J Gynecol Cancer* 2022;32:28-40.
15. Euscher E. Pathology of sentinel lymph nodes: historical perspective and current applications in gynecologic cancer. *Int J Gynecol Cancer* 2020;30:394-401.
16. Hudack SS, McMaster PD. THE LYMPHATIC PARTICIPATION IN HUMAN CUTANEOUS PHENOMENA : A STUDY OF THE MINUTE LYMPHATICS OF THE LIVING SKIN. *J Exp Med* 1933;57:751-774.
17. Walker LA. Localization of radioactive colloids in lymph nodes. *J Lab Clin Med* 1950;36:440-449.
18. Aitken DR, Hinkle GH, Thurston MO, Tuttle SE, Martin DT, Olsen J, et al. A gamma-detecting probe for radio-immune detection of CEA-producing tumors. Successful experimental use and clinical case report. *Dis Colon Rectum* 1984;27:279-282.
19. Nieweg OE, Uren RF, Thompson JF. The History of Sentinel Lymph Node Biopsy. *Cancer J* 2015;21:3-6.
20. Sugie T, Sawada T, Tagaya N, Kinoshita T, Yamagami K, Suwa H, et al. Comparison of the Indocyanine Green Fluorescence and Blue Dye Methods in Detection of Sentinel Lymph Nodes in Early-stage Breast Cancer. *Ann Surg Oncol* 2013;20:2213-2218.
21. Sugie T, Kinoshita T, Masuda N, Sawada T, Yamauchi A, Kuroi K, et al. Evaluation of the Clinical Utility of the ICG Fluorescence Method Compared with the Radioisotope Method for Sentinel Lymph Node Biopsy in Breast Cancer. *Ann Surg Oncol* 2016;23:44-50.
22. Zeng H-C, Hu J-L, Bai J-W, Zhang G-J. Detection of Sentinel Lymph Nodes with Near-Infrared Imaging in Malignancies. *Mol Imaging Biol* 2019;21:219-227.
23. Buda A, Bussi B, Di Martino G, Di Lorenzo P, Palazzi S, Grassi T, et al. Sentinel Lymph Node Mapping With Near-Infrared Fluorescent Imaging Using Indocyanine Green: A New Tool for Laparoscopic Platform in Patients With Endometrial and Cervical Cancer. *J Minim Invasive Gynecol* 2016;23:265-269.
24. Rossi EC, Kowalski LD, Scalici J, Cantrell L, Schuler K, Hanna RK, et al. A comparison of sentinel lymph node biopsy to lymphadenectomy for endometrial cancer staging (FIRES trial): a multicentre, prospective, cohort study. *Lancet Oncol* 2017;18:384-392.
25. Kim S, Ryu KJ, Min KJ, Lee S, Jung US, Hong JH, et al. Learning curve for sentinel lymph node mapping in gynecologic malignancies. *J Surg Oncol* 2020;121: 599-604.
26. Jeremiasse B, van den Bosch CH, Wijnen MWHA, Terwisscha van Scheltinga CEJ, Fiocco MF, van der Steeg AFW. Systematic review and meta-analysis concerning near-infrared imaging with fluorescent agents to identify the sentinel lymph node in oncology patients. *Eur J Surg Oncol* 2020;46:2011-2022.
27. Echt ML, Finan MA, Hoffman MS, Kline RC, Roberts WS, Fiorica JV. Detection of sentinel lymph nodes with lymphazurin in cervical, uterine, and vulvar malignancies. *South Med J* 1999;92:204-208.
28. Levinson KL, Mahdi H, Escobar PF. Feasibility and optimal dosage of indocyanine green fluorescence for sentinel lymph node detection using robotic single-site instrumentation: preclinical study. *J Minim Invasive Gynecol* 2013;20:691-696.
29. Cormier B, Diaz JP, Shih K, Sampson RM, Sonoda Y, Park KJ, et al. Establishing a sentinel lymph node mapping algorithm for the treatment of early cervical cancer. *Gynecol Oncol* 2011;122:275-280.
30. Benedetti Panici P, Basile S, Maneschi F, Alberto Lissoni A, Signorelli M, Scambia G, et al. Systematic pelvic lymphadenectomy vs. no lymphadenectomy in early-stage endometrial carcinoma: randomized clinical trial. *J Natl Cancer Inst* 2008;100:1707-1716.
31. group As, Kitchener H, Swart AMC, Qian Q, Amos C, Parmar MKB. Efficacy of systematic pelvic lymphadenectomy in endometrial cancer (MRC ASTEC trial): a randomised study. *Lancet* 2009;373:125-136.
32. Ballester M, Dubernard G, Lécure F, Heitz D, Mathevet P, Marret H, et al. Detection rate and diagnostic accuracy of sentinel-node biopsy in early stage endometrial cancer: a prospective multicentre study (SENTI-ENDO). *Lancet Oncol* 2011;12:469-476.
33. Rossi EC. Current state of sentinel lymph nodes for women with endometrial cancer. *Int J Gynecol Cancer* 2019;29:613-621.
34. Eoh KJ, Lee YJ, Kim H-S, Lee J-Y, Nam EJ, Kim S, et al. Two-step sentinel lymph node mapping strategy in endometrial cancer staging using fluorescent imaging: A novel sentinel lymph node tracer injection procedure. *Surg Oncol* 2018;27:514-519.
35. Kim YN, Eoh KJ, Lee JY, Nam EJ, Kim S, Kim YT, et al. Comparison of outcomes between the one-step and two-step sentinel lymph node mapping techniques in endometrial cancer. *Int J Gynecol Cancer* 2020;30:318-324.
36. Seon KE, Lee YJ, Lee J-Y, Nam EJ, Kim S, Kim YT, et al. Sentinel lymph node mapping in endometrial cancer staging: Two-step technique with the da Vinci SP system. *Gyne Robot Surg* 2023;4:37-38.

37. Barlin JN, Khoury-Collado F, Kim CH, Leitao MM, Jr., Chi DS, Sonoda Y, et al. The importance of applying a sentinel lymph node mapping algorithm in endometrial cancer staging: beyond removal of blue nodes. *Gynecol Oncol* 2012;125:531-535.
38. Lago V, Bello P, Montero B, Matute L, Padilla-Iserte P, Lopez S, et al. Sentinel lymph node technique in early-stage ovarian cancer (SENTOV): a phase II clinical trial. *Int J Gynecol Cancer* 2020;30:1390-1396.
39. Uccella S, Nero C, Vizza E, Vargiu V, Corrado G, Bizzarri N, et al. Sentinel-node biopsy in early-stage ovarian cancer: preliminary results of a prospective multicentre study (SELY). *Am J Obstet Gynecol* 2019;221:324.e1-e10.
40. Cosentino F, Vizzielli G, Turco LC, Fagotti A, Cianci S, Vargiu V, et al. Near-Infrared Imaging with Indocyanine Green for Detection of Endometriosis Lesions (Gre-Endo Trial): A Pilot Study. *J Minim Invasive Gynecol* 2018;25:1249-1254.
41. Seracchioli R, Raimondo D, Arena A, Zanello M, Mabrouk M. Clinical use of endovenous indocyanine green during rectosigmoid segmental resection for endometriosis. *Fertil Steril* 2018;109:1135.
42. Wada T, Kawada K, Takahashi R, Yoshitomi M, Hida K, Hasegawa S, et al. ICG fluorescence imaging for quantitative evaluation of colonic perfusion in laparoscopic colorectal surgery. *Surg Endosc* 2017;31:4184-4193.