Clinical Value of Preoperative Lymphoscintigraphy in Patients with Early Cervical Cancer Considered for Intraoperative Lymphatic Mapping

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Abstract. *The purpose of this study was to examine the clinical usefulness of preoperative lymphoscintigraphy (PLS) for sentinel node identification in patients undergoing lymphatic mapping during surgery for early cervical cancer. Patients and Methods: Day-before PLS was performed in 42 patients who were candidates for open radical hysterectomy and intraoperative lymphatic mapping, using a combination of radiocolloid and blue dye technique. Results: In 39 patients, at least one sentinel node (SN) was evident either in the lymphoscintigram or during the operation (detection rate 92.8%). Lymphoscintigraphy revealed unilateral SNs in 24 (61.5%) cases and bilateral SNs in 15 (38.5%). A total of 56 SNs were identified. Intraoperatively, 5 out of 24 patients with unilateral SNs on PLS had bilateral identification. The total number of SNs retrieved was 103 (2.6/patient). While one SN was identified in 25 cases on PLS, 32 patients had two or more SNs intraoperatively. The agreement between preoperative and intraoperative detection regarding laterality, number and location of SNs was poor (Kappa<0.69). Conclusion: PLS is of limited clinical value for intraoperative SN detection in early cervical cancer.*

For cancer of the cervix, lymphatic mapping is performed using a blue dye and/or radioisotopic techniques (1-9). According to the existing data, sentinel node(SN) detection rates are generally higher with the dual approach and radioisotopic techniques provide better results than the blue dye technique alone (6-9). Lymphatic mapping with Tc99m-labeled radiocolloid includes preoperative lymphoscintigraphy (PLS) and intraoperative detection of SN using a gamma probe. Recently, the usefulness of PLS in clinical practice is being questioned on the basis of discordance between the findings of PLS and intraoperative lymphatic mapping (ILM) (10-13).

The aim of this study was to compare the findings of PLS with the intraoperative detection of SNs and evaluate its usefulness in patients with early cervical cancer considered for SN biopsy.

Patients and Methods

Between January 2006 and May 2009, SN lymphatic mapping was performed in 45 patients for whom an open radical surgery for early cervical cancer was planned. All patients signed an informed consent. Patients who had neo-adjuvant treatment, radiotherapy/ chemotherapy or both were excluded from the study. In three cases, the blue dye technique was used alone. In the remaining 42 patients, the dual technique (blue dye and Tc99m colloid albumin injection) was applied and PLS under a gamma camera was performed.

Preoperative lymphoscintigraphy. The same protocol in terms of timing, radiocolloid dosages and injection sites was used in all patients. The administration of the radiocolloid tracer (total volume 0.8 ml containing 3 mCi of Tc99m divided equally into four injections of 0.2 ml each) was performed the afternoon before surgery, 16-18 hours before the operation. Injections were applied to all four quadrants of the cervix, at the periphery of any visible tumor or inflammation. Each of them contained 0.75 mCi of Technetium-99 colloid albumin (Nanocoll, Amersham GE Healthcare, Italy) measured again on the spot just before the application. At least 95% of human albumin colloidal particles had a diameter ≤80 nm.

A static scintigram under a gamma camera was taken one hour after the injection to document radioactive colloid uptake and a second one in two hours to determine the number and location of the SNs.

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Injection of blue dye. This was carried out after induction of anesthesia, just before surgery. A 2 ml ampoule of blue patente (Guerbet, Switzerland) diluted in 4 ml of normal saline and divided into four injections of 1.5 ml each was delivered to the four quadrants of the cervix in the same manner as the radiocolloid.

Intraoperative lymphatic mapping. All patients underwent an open radical hysterectomy and systematic pelvic lymphadenectomy. Immediately after opening the abdomen, SNs were identified either by their blue color and/or using a hand-held collimated gamma-probe (GPS navigator) with a threshold setting for Tc99m (125-155 KeV) designed for transperitoneal localization. Any region that produced approximately 10-fold more counts than the background was considered to host an SN, in accordance with the literature (9, 14, 15). Resected SNs (hot and/or blue) were re-measured *ex vivo* for radiation. The duration of the procedure was 15-40 min (mean 30 min).

Pathological evaluation. SNs were sent separately for standard and enhanced pathological analysis (ultrastaging) after marking their location. Pelvic nodes were sent for histological examination in groups as obturator, interiliac, external iliac, common iliac and lower para-aortic. Tumor size was determined after formalin fixation and lymphatic vascular space invasion (LVSI) was defined as present if multiple foci of invasion were recognized around the tumor, or if there was massive lymphatic invasion with a spray-like growth.

Statistical analysis. Statistics were calculated using the SPSS program ver. 15 (SPSS Inc. USA). Cohen's kappa coefficient was used as a statistical measure of qualitative agreement and kappa (K) values were interpreted as follows: ≤0.70: poor agreement; 0.70-0.85: substantial agreement; 0.86-1.00: perfect agreement. Diagnostic indices (sensitivity, specificity, accuracy, negative (NPV) and positive (PPV) predictive values) were calculated using a 2X2 table with true positives, true negatives, false negatives, and false positives. *P*-values <0.05 were considered significant.

Results

Preoperative lymphoscintigraphy. The general patient characteristics are presented in Table I. In 39 out of 42 patients, at least one hot spot was identified in the lymphoscintigram. The total number of hot spots was 56 (1.4 per patient). Multiple hot spots were recorded in 14 cases. No SNs were identified outside the pelvis in the absence of pelvic SNs, *i.e.* aberrant lymphatic flow was not demonstrated in this study. The topographic distribution of SNs was as follows: obturator 33.3%, interiliac 21.4%, external iliac 26.2%, common iliac 9.5%, lower para-aortic 2.4% (Table II). Lymphoscintigraphy revealed unilateral SNs in 24 cases (61.5%) and bilateral in 15 (38.5%). Laterality was not significantly associated with lymph node metastases (p=0.233) or the presence of LVSI (p=0.617). However, a significant correlation between tumor size and laterality was noted when cases were stratified in groups of tumors >2 cm and ≤2 cm (p=0.03, Table III).

Table I. *Disease characteristics and SN detection rate.*

Variable	Patient numbers	%
Stage		
IA2	3	7.1
IB1	37	88.1
IIA	2	4.8
Histology		
Squamous	39	92.9
Adenocarcinoma	3	7.1
Tumor size (cm)		
≤2	17	40.5
>2	25	59.5
LVSI		
Present	7	16.7
Absent	35	83.3
Patients with nodal metastases	8	19
Sentinel not detected	3	7.1
False negatives	1	2.4
Detection rate	39/42	92.9

Intraoperative lymphatic mapping. A total of 103 SNs were retrieved from 39 successful intraoperative detections (2.6/patient). The anatomic distribution of SNs is shown in Table II. Bilateral SNs were harvested in 19 (48.7%) patients and unilateral in 20 (51.3%).

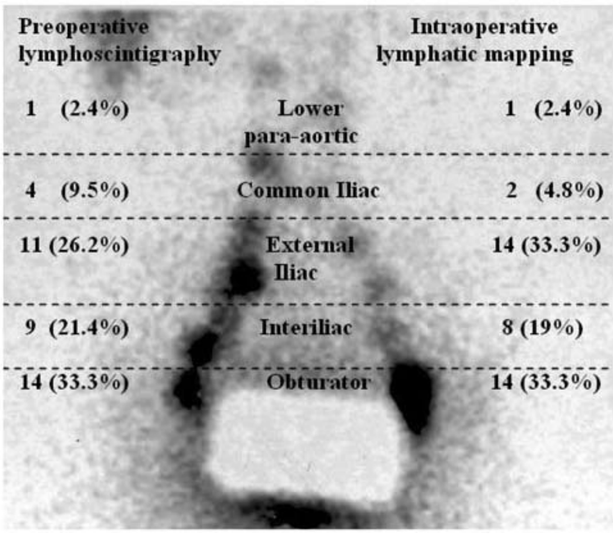
Correlation of preoperative lymphoscintigraphy with intraoperative lymphatic mapping. The number of patients in whom at least one SN was identified on PLS and ILM (using the dual method) was equal (39 out of 42 cases). However, the total number of SNs harvested intraoperatively was much higher (n=103) than the number of hot spots identified during lymphoscintigraphy (n=56). On PLS, 25 patients showed only one SN location, while during the operation, 32 proved to have 2 or more SN locations (K=0.218 Table IV). Of 19 cases with bilateral detection of SNs during ILM, PLS showed unilateral hot spots in 5 (K=0.69 Table V). The correlative anatomic distribution of SNs on PLS and ILM is shown in Table VI. The degree of concordance between them as measured by Cohen's kappa value was poor (K=0.284).

General diagnostic indices. The diagnostic indices concerning the verification of the SN concept were calculated from Table VII. There was one false-negative case (2.38%). Sensitivity was 80%, specificity 97%, accuracy 94.8%, NPV 97%, and PPV 80%.

Discussion

The literature data show that SN detection is feasible in 80% to 100% of patients with early cervical cancer undergoing open or laparoscopic surgery (3-9, 14-19). The results of this

Table II. *Preoperative and intraoperative SN locations. The relative proportions may seem similar but the location was different when examined case by case.*



Preoperative lymphoscintigraphy		Intraoperative lymphatic mapping
1 (2.4%)	Lower para-aortic	1 (2.4%)
4 (9.5%)	Common Iliac	2 (4.8%)
11 (26.2%)	External Iliac	14 (33.3%)
9 (21.4%)	Interiliac	8 (19%)
14 (33.3%)	Obturator	14 (33.3%)

Table III. *Preoperative detection laterality and final tumor size (p=0.03).*

	Tumor size		Total
Gamma camera laterality	≤2 cm	>2 cm	
Unilateral	6	18	24
Bilateral	11	4	15
Total	17	22	39

Table IV. *Concordance of the number of SN locations between lymphoscintigraphy and intraoperative detection K=0.218.*

	Intraoperative SNs (cases)		Total
Preoperative SNs	≥2	<2	
≥2	14	0	14
<2	18	7	25
Total	32	7	39

Table V. *Preoperative versus intraoperative detection and laterality (K=0.69).*

	Intraoperative laterality		
	Unilateral	Bilateral	Total
Gamma camera laterality			
Unilateral	19	5	24
Bilateral	1	14	15
Total	20	19	39

study are in agreement with the previous data, showing successful identification of the SN in 93% (39/42) of patients using the dual technique. Overall diagnostic test indices concerning the validity of the SN concept (whether it reflects the status of the other nodes) such as sensitivity, specificity, accuracy, NPV and PPV were 80%, 97%, 94.8%, 97% and 80% respectively, in accordance with the value ranges reported in the literature (3-22).

Currently, PLS is used with ILM for SN detection. In this study, although PLS successfully depicted hot spots in all patients in whom intraoperative SNs were identified, it was however inferior to ILM regarding laterality of SN detection, number of SNs retrieved and anatomical location. According to the presented data, PLS failed to detect bilateral SNs in 5 out of 19 (26.3%) cases, making the concordance of preoperative and intraoperative lymphatic mapping poor (K=0.69). Furthermore, after a case by case examination, preoperative and operative SN anatomical correlation was even lower (K=0.284). As far as the actual number of SNs is concerned, 25 patients where found to have only one SN on PLS, but 32 had 2 or more SNs intraoperatively (poor concordance, K=0.218).

There are only three studies in the literature focusing on the concordance between the findings of preoperative lymphoscintigraphy and surgical SN mapping (10, 12, 13). Their results, shown in Table VIII, are similar to the present data, indicating a poor correlation between preoperative and ILM. Frumovitz *et al*. found that surgical lymphatic mapping revealed more than one sentinel lymph basin in 15 out of 21 patients with solitary SNs and bilateral SN basins in 11 out of 25 patients with unilateral SN detection on PLS (13). Bats *et al*. reported that 3 out of 11 patients without hot spots on lymphoscintigraphy showed at least one SN intraoperatively. In 25.7% of cases with unilateral preoperative detection, SNs on both sides were found at surgery and 16 out of 27 patients had solitary SN on lymphoscintigraphy but bilateral SNs during surgery (12). In a recent study of 56 patients undergoing radical surgery for cervical cancer, Vieira *et al*. (10) evaluated the role of gamma camera lymphoscintigraphy. They found a poor concordance in the detection of SNs between PLS and ILM using the dual technique and concluded that PLS in not useful for SN identification.

Admittedly, lymphatic mapping using a gamma camera has limitations. One major concern when using radiocolloids is the inability to detect small parametrial nodes, either preoperatively or intraoperatively, because of their proximity to the cervix which gives a high signal (9, 10). Another

Table VI. *Correlative anatomical distribution of preoperative and intraoperative SN locations (K=0.284).*

	Intraoperative location					
	Obturator	Interiliac	Ext. Iliac	Com. Iliac	Paraaortic	Totals
Gamma camera location						
Obturator	6	4	4	0	0	14
Interiliac	4	3	2	0	0	9
Ext. Iliac	3	0	8	0	0	11
Com. Iliac	1	0	0	2	1	4
Paraaortic	0	1	0	0	0	1
Total	14	8	14	2	1	39

disadvantage is the inability to preoperatively pinpoint the nodes themselves, depicting rather a group of nodes than a specific one on the separate hot spots (9, 13). In addition, a possible reason for the discrepancy in the number of SNs is that after 16-18 hours following the injection, the radiocolloid migrates to second-tier lymph nodes (12, 15) thus increasing the intraoperative hot sentinel yield. However, this migration has not been demonstrated in some studies concerning lymphatic mapping in melanoma and breast cancer (13, 23).

Our findings and previous data (10, 12, 13, 24) have shown a poor correlation of PLS and surgical mapping regarding the anatomical location of SNs. A disadvantage of PLS is the inability to determine the exact anatomical positions of the SNs because it cannot simultaneously depict the pelvic vessels nor the bony anatomy, *i.e.* there are no precise landmarks on the two-dimensional lymphoscintigram that correlate with the pelvic anatomy. The intraoperative anatomical localization of the SN has been addressed in several studies with various results. In most of them, the SN was more frequently located in the external iliac region (10-13, 20-22). Other studies indicate that the intermediate nodal group (interiliac and/or obturator) is the most common site of SN localization (25-27). Our data suggest that in surgical mapping, SNs are found with equal frequency in the external iliac and obturator (33.3%) lymph basins followed by the interiliac nodal group (19%). The variability of the data stress the importance of careful exploration of all nodal groups during surgery.

In our study, a considerable proportion (5/24) of patients were found to have unilateral SNs in PLS, but bilateral SNs during surgical mapping. Since the cervix is a midline organ with bilateral lymph drainage and the injections are administered to all four quadrants, one would expect that the lymphatic mapping would depict bilateral SNs in most of the cases of early cervical cancer. However, bilateral SN detection is not the rule, even during ILM. Its reported frequency in the literature ranges from 25% to 84% (9, 20). Low bilateral SN

Table VII. *SN concept validation, case by case report.*

	Non-SN histology		
	Negative	Positive	Total
SN Histology			
Negative	33	1	34
Positive	1	4	5
SN ND	1	2	3
Total	35	7	42

*ND: Not detected.

identification may be the result of technical differences or pitfalls (3, 12, 20, 24), true physiological and/or unilaterally dominated lymph flow (13, 28), impairment of lymphatic drainage by tumor (15), lymphovascular invasion (11, 29), increased primary tumor size (11, 12, 29), or alterations of lymphatic flow by neoadjuvant treatments or by concomitant benign pathology (10).

The correlation of PLS laterality (bi- or unilateral SN detection) with the presence of nodal metastases or LVSI in this study did not show any significant association (p=0.233 and p=0.617 respectively). A statistically significant association was found (p=0.03) after stratification of the cases into groups of tumors larger or smaller than 2 cm, indicating that for patients with larger tumors, unilateral detection is more likely. However, further studies are needed to clarify the importance, if any, of the unilaterally detected SN in a midline organ such as the cervix.

It should be acknowledged that certain factors in our study may have contributed to the inferior results of PLS versus ILM. Using the combined technique (blue dye and gamma-probe) for intraoperative detection, it was easier to identify more SNs. Moreover, knowledge of the results of PLS might interfere with the detection of SNs intraoperatively. PLS

Table VIII. *Concordance between lymphoscintigraphic and intraoperative lymphatic mapping. Previous data and present study.*

	No. of cases	Anatomic location	Laterality	SN number
Frumovitz et al. (13)	50	Poor (K=–0.07)	Poor	Poor
Bats et al. (12)	71	NR	Poor (K=0.44)	Poor (K=0.05)
Vieira et al. (10)	56	NR	Poor (K≤0.118)	NR
This study	42	Poor (K=0.284)	Poor (K=0.69)	Poor (K=0.218)

*Interpretation of K values: <0.70 poor agreement, 0.70-0.85 substantial agreement, 0.86-1.00 perfect agreement. NR: Not reported.

revealed at least one SN in all our patients in whom SN identification was possible at surgery ($p<0.001$). This implies that the administration of the radiocolloid was correctly performed and this information can be used as an internal quality control measure. Since lymphatic mapping is a relatively new method, the skill level of the surgeons in intraoperatively identifying and/or localizing SNs may be limited initially. Another potential advantage of PLS is the ability to detect aberrant lymphatic flow. There are cases in the literature in which SNs in cervical cancer were detected in the inguinal region (30).

In conclusion, PLS may be useful in the beginning of the learning curve and during the standardization of the technique regarding dosages, volumes and timing of colloid injections as a quality control measure. But since it cannot accurately predict either laterality, location or the number of SNs that will be harvested surgically, it is of limited value for the intraoperative detection of SNs.

References

1 O'Boyle JD, Coleman RL, Bernstein SG, Lifshitz S, Muller CY and Miller DS: Intraoperative lymphatic mapping in cervix cancer patients undergoing radical hysterectomy: A pilot study. Gynecol Oncol *79*: 238-243, 2000.

2 Verheijen RH, Pijpers R, van Diest PJ, Burger CW, Buist MR and Kenemans P: Sentinel node detection in cervical cancer. Obstet Gynecol *96*: 135-138, 2000.

3 Dargent D, Martin X and Mathevet P: Laparoscopic assessment of the sentinel lymph node in early stage cervical cancer. Gynecol Oncol *79*: 411-415, 2000.

4 Malur S, Krause N, Kohler C and Schneider A: Sentinel lymph node detection in patients with cervical cancer. Gynecol Oncol *80*: 254-257, 2001.

5 Lantzsch T, Wolters M, Grimm J, Mende T, Buchmann J, Sliutz G and Koelbl H: Sentinel node procedure in Ib cervical cancer: a preliminary series Br J Cancer *85*: 791-794, 2001.

6 Plante M, Renaud MC, Tetu B, Harel F and Roy M: Laparoscopic sentinel node mapping in early-stage cervical cancer. Gynecol Oncol *91*: 494-503, 2003.

7 Van Dam PA, Hauspy J, Vanderheyden T, Sonnemans H, Spaepen A, Eggenstein G, Dirix L and Verkinderen L: Intraoperative sentinel node identification with Technetium-99m-labeled nanocolloid in patients with cancer of the uterine cervix: a feasibility study. Int J Gynecol Cancer *13*: 182-186, 2003.

8 Wydra D, Sawicki S, Emerich J and Romanowicz G: The influence of depth of marker administration on sentinel node detection in cervical cancer. Nucl Med Rev Cent East Eur *6*: 131-133, 2003.

9 Levenback C, Coleman RL, Burke TW, Lin WM, Erdman W, Deavers M and Delpassand ES: Lymphatic mapping and sentinel node identification in patients with cervix cancer undergoing radical hysterectomy and pelvic lymphadenectomy. J Clin Oncol *20*: 688-693, 2002.

10 Vieira SC, Sousa RB, Tavares MB, Silva JB, Abreu BA, Santos LG, da Silva BB and Zeferino LC: Preoperative pelvic lymphoscintigraphy is of limited usefulness for sentinel lymph node detection in cervical cancer. Eur J Obstet Gynecol Reprod Biol *145*: 96-99, 2009.

11 Fader AN, Edwards RP, Cost M, Kanbour-Shakir A, Kelley JL, Schwartz B, Sukumvanich P, Comerci J, Sumkin J, Elishaev E and Rohan LC: Sentinel lymph node biopsy in early-stage cervical cancer: utility of intraoperative versus postoperative assessment. Gynecol Oncol *111*: 13-17, 2008.

12 Bats AS, Lavoué V, Rouzier R, Coutant C, Kerrou K and Daraï E: Limits of day-before lymphoscintigraphy to localize sentinel nodes in women with cervical cancer. Ann Surg Oncol *15*: 2173-2179, 2008.

13 Frumovitz M, Coleman RL, Gayed IW, Ramirez PT, Wolf JK, Gershenson DM and Levenback CF: Usefulness of preoperative lymphoscintigraphy in patients who undergo radical hysterectomy and pelvic lymphadenectomy for cervical cancer. Am J Obstet Gynecol *194*: 1186-1193, 2006.

14 Buist MR, Pijpers RJ, van Lingen A, van Diest PJ, Dijkstra J, Kenemans P and Verheijen RH: Laparoscopic detection of sentinel lymph nodes followed by lymph node dissection in patients with early stage cervical cancer. Gynecol Oncol *90*: 290-296, 2003.

15 Hauspy J, Beiner M, Harley I, Ehrlich L, Rasty G and Covens A: Sentinel lymph nodes in early stage cervical cancer. Gynecol Oncol *105*: 285-290, 2007.

16 Lambaudie E, Collinet P, Narducci F, Sonoda Y, Papageorgiou T, Carpentier P, Leblanc E and Querleu D: Laparoscopic identification of sentinel lymph nodes in early stage cervical cancer: prospective study using a combination of patent blue dye injection and technetium radiocolloid injection. Gynecol Oncol *89*: 84-87, 2003.

17 Martínez-Palones JM, Gil-Moreno A, Pérez-Benavente MA, Roca I and Xercavins J: Intraoperative sentinel node identification in early stage cervical cancer using a combination of radiolabeled albumin injection and isosulfan blue dye injection. Gynecol Oncol *92*: 845-850, 2004.

18 Marnitz S, Köhler C, Bongardt S, Braig U, Hertel H and Schneider A; German Association of Gynecologic Oncologists (AGO). Topographic distribution of sentinel lymph nodes in patients with cervical cancer. Gynecol Oncol *103*: 35-44, 2006.

19 Roca I, Caresia AP, Gil-Moreno A, Pifarre P, Aguade-Bruix S, Castell-Conesa J, Martínez-Palones JM and Xercavins J: Usefulness of sentinel lymph node detection in early stages of cervical cancer. Eur J Nucl Med Mol Imaging *32*: 1210-1216, 2005.

20 Wydra D, Sawicki S, Wojtylak S, Bandurski T and Emerich J: Sentinel node identification in cervical cancer patients undergoing transperitoneal radical hysterectomy: a study of 100 cases. Int J Gynecol Cancer *16*: 649-654, 2003.

21 Di Stefano AB, Acquaviva G, Garozzo G, Barbic M, Cvjeticanin B, Meglic L, Kobal B and Rakar S: Lymph node mapping and sentinel node detection in patients with cervical carcinoma: a 2-year experience. Gynecol Oncol *99*: 671-679, 2005.

22 Angioli R, Palaia I, Cipriani C, Muzii L, Calcagno M, Gullotta G and Panici PB: Role of sentinel lymph node biopsy procedure in cervical cancer: a critical point of view. Gynecol Oncol *96*: 504-509, 2005.

23 Pijpers R, Buist MR, van Lingen A, Dijkstra J, van Diest PJ, Teule GJ, Kenemans P and Verheijen RH: The sentinel node in cervical cancer: scintigraphy and laparoscopic gamma probe-guided biopsy. Eur J Nucl Med Mol Imaging *11*: 1479-1486, 2004.

24 Lavoué V, Bats AS, Rouzier R, Coutant C, Barranger E and Daraï E: Sentinel lymph node procedure followed by laparoscopic pelvic and paraaortic lymphadenectomy in women with IB2-II cervical cancer. Ann Surg Oncol *14*: 2654-2661, 2007.

25 Daraï E, Lavoué V, Rouzier R, Coutant C, Barranger E and Bats AS: Contribution of the sentinel node procedure to tailoring the radicality of hysterectomy for cervical cancer. Gynecol Oncol *106*: 251-256, 2007.

26 Sakuragi N, Satoh C, Takeda N, Hareyama H, Takeda M, Yamamoto R, Fujimoto T, Oikawa M, Fujino T and Fujimoto S: Incidence and distribution pattern of pelvic and paraaortic lymph node metastasis in patients with Stages IB, IIA, and IIB cervical carcinoma treated with radical hysterectomy. Cancer *85*: 1547-1554, 1999.

27 Yuan SH , Xiong Y, Wei M, Yan XJ, Zhang HZ, Zeng YX and Liang LZ: Sentinel lymph node detection using methylene blue in patients with early cervical cancer. Gynecol Oncol *106*: 147-152, 2007.

28 Lelievre L, Camatte S, Le Frere-belda MA, Kerrou K, Froissart M, Taurelle R, Vilde F and Lecuru F: Sentinel lymph node biopsy in cervix and corpus uteri cancers. Int J Gynecol Cancer *14*: 271-278, 2004.

29 Zarganis P, Kondi-Pafiti A, Arapantoni-Dadioti P, Trivizaki E, Velentzas K, Vorgias G and Fotiou S: The sentinel node in cervical cancer patients: role of tumor size and invasion of lymphatic vascular space. In Vivo *23*: 469-473, 2009.

30 Hauspy J, Verkinderen L, De Pooter C, Dirix LY and van Dam PA: Sentinel node metastasis in the groin detected by technetium-labeled nannocolloid in a patient with cervical cancer. Gynecol Oncol *86*: 358-360, 2002.

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