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Evaluation of serum levels of soluble (s)L- and (s)P-selectins in endometrial cancer

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Short title: sL- and sP-selectins in endometrial cancer

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ABSTRACT

Objectives: A number of reports on the role of selectin in the process of carcinogenesis, at the stage of proliferation and metastasis, have been available.
The aim of the study was to analyze (s)P- and (s)L-selectin serum concentrations in women with EC and to compare these concentrations to clinical/pathological parameters and disease progression using surgical-pathological staging data.
Material and methods: A total of 46 patients with EC and 50 healthy controls were included in the study. Serum concentrations of sL- and sP-selectins were measured in all participants. The oncologic protocol was implemented in all women from the study group.
Results: Significantly higher serum concentrations were found in EC women as compared to controls. No statistically significant differences were found between the concentrations of the soluble forms of selectins and the following parameters: histologic type of EC, histologic tumor differentiation, depth of myometrial infiltration, cervical involvement, distant

metastases, vascular space invasion, and disease advancement. Slightly higher (s)P-selectin concentrations were observed in serous carcinoma, in women with cervical involvement, in the sera of women with vascular space invasion and with advanced stages of the disease. Slightly higher mean (s)P-selectin concentrations correlated with lower differentiation of the tumor. Slightly higher mean (s)P-selectin concentration was detected in the sera of women with lymph node metastases and with the serosal and/or adnexal involvement. The results were statistically insignificant, but they almost reached statistical significance.
Conclusions: L- and P-selectins play a role in the biology of EC. The absence of an unambiguous relationship between differences in (s)L- and (s)P-selectin levels and disease advancement suggests that they do not play a vital role in tumor progression in endometrial cancer.
Key words: endometrial cancer; L-selectin; P-selectin

INTRODUCTION

L- and P-selectins (CD62) are members of the family of calcium-dependent cell adhesion molecules which mediate the specific reactions between endothelial cells, leukocytes, and blood platelets [1, 2]. In the body, selectins may take two different forms: transmembrane proteins, which are anchored to the cell membrane and function as membrane receptors, and soluble proteins, without the transmembrane fragment, which are released into the circulation and found in serum, plasma, and other body fluids [1, 3].

A number of reports about selectin participation in the process of carcinogenesis, at the stage of proliferation and metastasis, have been published. According to some studies, selectins may play an important role in the formation of metastases at the stage of trapping and vascularization of cancer cells in the targeted metastatic tissues. Most analyses of serum (s)P- and (s)L-selectin concentrations found elevated levels in the sera of patients with various malignancies: colorectal, breast, ovarian and lung cancer, malignant melanoma, acute myeloid leukemia, and others. To the best of our knowledge, only one publication on the role of (s)L-selectin in the biology of endometrial cancer (EC) and no reports on the role of (s)P-selectin in the oncogenesis of endometrial cancer have been published [1, 4].

Objectives

The aim of the study was to evaluate (s)P- and (s)L-selectin serum concentrations in women with endometrial cancer, and to analyze their concentrations as compared to

clinical/pathological parameters and disease progression using surgical-pathological staging data.

MATERIAL AND METHODS

A total of 96 women (46 with EC — study group and 50 controls with no malignancies: uterine myomas, pelvic organ prolapses, benign ovarian cysts — control group), hospitalized at the Clinic of Surgical, Endoscopic and Oncologic Gynecology, Polish Mother's Memorial Hospital, Łódź between 2013–2015, were included in the study. Serum (s)L- and (s)P-selectin levels were measured in all patients 2 days preoperatively. The Local Ethics Committee approved of the study (no: 71/2012). The oncologic protocol was implemented in all participants from the study group.

Pelvic lymph node dissection was performed in 40 women. Internal, external, and obturator iliac lymph nodes were dissected. The surgery was abandoned in six women due to poor overall health condition or very low risk of lymph node involvement based on the pre- and mid-surgery evaluation. The 2009 International Federation of Gynaecology and Obstetrics (FIGO) staging classification was used to determine disease advancement.

History of chemotherapy or radiotherapy due to malignant neoplasms, history of any malignancy, recurrent endometrial cancer, and hormonal therapy use (pharmacological forms of female sex hormones, *i.e.*, contraceptives, HRT) constituted the exclusion criteria.

Immunoenzymatic analysis of serum (s)L- and (s)P-selectin concentration

In the morning, 5 ml of fasting blood samples were drawn from the ulnar vein into plastic tubes without anticoagulants and transported to the laboratory within one hour of collection. Next, the samples were centrifuged at 1500 × g for 10 min., and the serum was gently separated, divided into portions, and stored at –80ºC until used.

The sL- and sP-selectin concentrations were tested with immunoenzymatic ELISA using commercially available kits (R&D): Human sL-Selectin Immunoassay (sensitivity: 0.5ng/m), Human sP-Selectin Immunoassay (sensitivity: 0.5 ng/mL), according to the manufacturer's protocol. Absorbance was measured at 450 nm in the ELx 808 reader. The results are expressed as ng/mL.

Statistical analysis

Descriptive statistics were used to describe the relationships between the variables: measure of location (mean, median), distribution (standard deviation), and asymmetry (asymmetry index) for quantitative variables and percentage for qualitative variables.

Statistical analyses were carried out using the following tests:

- Student t to test quantitative parameters between 2 groups with normal distribution and homogeneity of variance (normality of distribution was tested using W Shapiro-Wilk test, Levene's and Brown-Forsythe tests were used to test homogeneity of variance);
- Cochran and Cox to test quantitative parameters with normal distribution but lacking homogeneity of variance;
- Mann-Whitney to test quantitative parameters between 2 groups with non-normal distribution or groups with statistically significantly different sample size (Chi^2 test was used to check equality of group proportions);
- ANOVA rang Kruskal-Wallis to test quantitative parameters between more than two groups with non-normal distribution or groups with statistically significantly different sample size (Chi^2 test was used to check equality of group proportions);
- Independent Pearson's chi2 to compare qualitative variables between two groups.

STATISTICA 6.0, with $\alpha = 0.05$ for statistical significance and $p < 0.05$ for the probability of error, was used for statistical analysis.

RESULTS

Statistical analysis of patient characteristics (study group and controls) is presented in Table 1. Clinical-Pathological characteristics of the study group are presented in Table 2. In the study group, 42 women were diagnosed with endometrial endometrioid adenocarcinoma and four with endometrial serous carcinoma. The tumor was well-differentiated (G1) in 19, moderately differentiated (G2) in 18, and poorly differentiated (G3) in nine women. Out of the 40 women who underwent lymphadenectomy, lymph node metastases were detected in 4 (10%) patients. Thirty (65.22%) women were diagnosed with FIGO stage I, 8 (17.39%) with stage II, 4 (8.70%) with stage III, and 4 (8.70%) with stage IV advancement (Tab. 2).

Statistically significantly elevated serum concentrations were found in the women with EC as compared to controls (Tab. 3). No statistically significant differences were found between the concentrations of the soluble forms of selectins and the following parameters: histologic type of EC, histologic tumor differentiation, depth of myometrial infiltration, cervical involvement, distant metastases, vascular space invasion, and disease advancement

(Tab. 4–12). However, slightly higher (s)P-selectin concentrations were observed in serous carcinoma, in women with cervical involvement, in the sera of women with vascular space invasion and with advanced stages of the disease (FIGO III and IV) (Tab. 4, 7, 11, 12). Slightly higher mean (s)P-selectin concentrations correlated with lower differentiation of the tumor (Tab. 5). Also, slightly higher mean (s)P-selectin concentration was detected in the sera of women with lymph node metastases and with the serosal and/or adnexal involvement. The results were statistically insignificant, but they almost reached statistical significance (Tab. 8–10).

Slightly higher (s)L-selectin concentrations correlated with lower differentiation of the tumor, disease advancement, tumor infiltration of over 50% of the myometrial thickness, vascular space involvement and distant metastases (Tab. 5, 6, 9, 11, 12). In case of serosal and/or adnexal involvement as well as lymph node metastases, the results were similar, if not identical, in both groups (Tab. 8 and 10).

DISCUSSION

In this study, statistically significantly higher concentrations of (s)L- and (s)P-selectin were found in the sera of women with EC as compared to controls. To the best of our knowledge, this has been the first attempt to assess serum (s)P-selectin levels in women with EC.

It is believed that elevated serum (s)P-selectin level in cancer patients may reflect platelet activation resulting from their interaction with tumor cells, which may in fact indicate the induction of the metastatic process. After platelet activation and degranulation, P-selectin expression on the surface of the thrombocytes is transient, whereas its soluble form is released and may be detected in the serum. Therefore, (s)P-selectin evaluation is a superior indicator of thrombocyte activation compared to the expression of its transmembrane form [1, 5].

Data on the role of P-selectin in endometrial cancer pathogenesis are relatively scarce, not to mention that so far only its transmembrane form and the presence of its ligands have been investigated. Thrombocytosis and thrombosis are common complications of malignant tumors, which is the basis of the hypothesis supporting the role of tumor cell-platelet interaction in the process of metastasis formation. P-selectin has been proposed as the indicator of that process [6, 7]. According to the available literature, P- and L-selectin may bind to sulfatides located not only on the surface of granulocytes but also tumor cells [8, 9]. Various studies confirmed a positive correlation between high levels of sulfatides and unfavorable prognosis in patients with ovarian and colorectal cancer. Also, sulfatide

overexpression was observed in tissue preparations of highly differentiated EC [10]. Various malignancies have been demonstrated to express the CD24 molecule, which is a ligand for P-selectin. P-selectin binds to the CD24 on the surface of the tumor cells, causing tumor cell adhesion to the endothelium, and, consequently, metastatic spread [11, 12].

Soluble P-selectin was assessed in other malignant tumors, e.g., ovarian, colorectal, lung cancer, myeloma and melanoma. Elevated (s)P-selectin levels were found in the sera of patients with malignant process as compared to controls, as was the case in our study [1, 5–7, 10,14–16]. Also, a relationship between serum (s)P-selectin level and disease advancement and distant metastases in patients with myeloma, melanoma, colorectal and lung cancer was reported [5, 15–18]. These findings might support the hypothesis about the role of the interaction between tumor cells with thrombocytes in the formation of metastatic foci [5]. In this study, higher (s)P-selectin concentrations in the sera of patients with endometrial serous cancer with unfavorable prognosis, as compared to endometrioid endometrial cancer, were found, although the difference was not statistically significant. Endometrial serous carcinoma is typically associated with unfavorable prognosis, a tendency for deeper myometrial involvement, metastases, and recurrence, which might be suggestive of a relationship between elevated serum (s)P-selectin concentrations and unfavorable prognostic factors, especially in that type of cancer. We detected increased (s)P-selectin levels in the sera of women with EC with cervical and serosal/adnexal involvement, lymph node and distant metastasis, as well as vascular space involvement. The results were statistically insignificant although they almost reached statistical significance in case of serosal/adnexal involvement and lymph node involvement. Also, we observed a relationship between higher (s)P-selectin concentration and lower tumor differentiation and higher disease advancement. These findings may support the hypothesis about the role of that molecule in the process of carcinogenesis in EC patients, especially at the stage of progression to an invasive phenotype and formation of metastatic foci and suggest a link between (s)P-selectin and negative prognostic factors. Furthermore, elevated (s)P-selectin in the sera of women with EC may reflect the biological potential of the tumor to metastasize.

In this study, statistically significantly higher concentrations of (s)L-selectin were detected in EC women as compared to controls. Similar results were reported by various authors who investigated (s)L-selectin levels in the sera of patients with other malignancies [1, 15, 19–21, 23–25]. L-selectin is present on the surface of all forms of leukocytes: T lymphocyte, monocyte, granulocyte subpopulations. It blinds leukocytes and endothelial cells of the lymphatic vessels. (s)L-selectin detachment from the leukocyte surface is believed to be

the regulatory mechanism of expressions and function of the transmembrane form of that molecule. Studies showed that (s)L-selectin detachment results in its decreased expression on the surface of the leukocytes. In consequence, the ability of neutrophils to migrate to the site of inflammation and blind to the microvascular endothelium of the lymph nodes is markedly decreased. A release of soluble (s)L-selectin from the surface of the leukocytes regulates their activity and modulates the inflammatory response [1]. Serum (s)L-selectin levels have not often been investigated in patients with malignant tumors. The exact role of (s)L-selectin in the process of carcinogenesis remains to be fully elucidated.

Czygier et al. [19], reported higher serum sL-selectin levels in women with early-stage breast cancer (grade I and II) as compared to healthy controls. However, these authors also found lowered serum concentration of (s)L-selectin in patients with advanced breast cancer (grade III and IV) and reported a further drop in its concentration after chemotherapy [26], which they believed resulted from fewer granulocytes and their deteriorated function caused by advanced-stage malignancy and chemotherapy [26]. Elevated serum (s)L-selectin levels were also detected in patients with acute myeloid and lymphoblastic leukemia before treatment and during disease recurrence, as well as an increase in sL-selectin concentrations which corresponded with tumor progression, and its decrease in patients with remission [20, 23, 25]. Notably, Czygier et al. [4], have been the first to measure (s)L-selectin concentrations in patients with endometrial and cervical cancer. They found statistically significantly lower (s)L-selectin levels in blood samples of these cancer patients as compared to controls, which they claimed was the consequence of the disruption of neutrophil rolling [4]. However, the expression of the transmembrane form and decreased ability of the leukocytes to migrate are lowered as the results of (s)L-selectin release, which makes it difficult to accept their interpretation of the results.

In this study, slightly lowered concentrations of (s)L-selectin, which correlated with lower tumor differentiation in EC women, were observed. Also, we detected slightly lowered levels of (s)L-selectin in the sera of women with myometrial invasion of > 50% and distant metastases, as well as in cases with vascular space involvement, and advanced stages of endometrial cancer (FIGO III and IV), although the results lacked statistical significance. Our findings may indicate that at the beginning of EC carcinogenesis the release of (s)L-selectin from leukocyte surface is intensified, which in turn leads to decreased expression of its transmembrane form and hinders the ability of the neutrophils to migrate to tumor site. One possible explanation is that this is how the tumor evades immune surveillance and protects itself against the attack from the immune system.

Leukocyte recruitment to the metastatic foci depends on the activity of L-selectin, whose absence leads to attenuation of metastasis [4]. Therefore, oncogenic progression is associated with gradual decrease of (s)L-selectin release in order to increase the expression of its transmembrane form and restore leukocyte migration. In that way, leukocytes might promote survival of the tumor cells located in the vessels, aid penetration of the endothelial barrier, and facilitate the formation of metastatic foci [27, 28]. L-selectin has been known to promote the survival of tumor cells in the circulation already 12–24 hours after they entered the bloodstream. Leukocytes which demonstrate L-selectin expression may help tumor cells penetrate the endothelial barrier and facilitate metastatic spread [28]. L-selectin expression on the surface of white-blood cells might create a favorable microenvironment for the metastatic cells by activating the inflammatory process [27, 28]. Additionally, by blocking the activity of L- and P-selectin, heparin inhibits the process of distant metastases formation in malignant carcinomas [4]. Similarly, in breast cancer, chemically modified heparin, by blocking L-selectin, inhibits tumor cell adhesion which prevents the formation of metastatic foci [29]. That hypothesis has been supported by the findings of Czygier et al., who reported elevated levels of (s)L-selectin in the sera of women with early-stage breast cancer and decreased serum (s)L-selectin concentrations in the patients with advanced stages of the disease (grade III and IV) [19, 26].

CONCLUSIONS

1. Differences in serum (s)L- and (s)P-selectin levels in women with EC versus controls indicate that L- and P-selectins play a role in the biology of endometrial cancer.
2. The absence of an unambiguous relationship between differences in (s)L- and (s)P-selectin levels and disease advancement suggests that they do not play a vital role in tumor progression in endometrial cancer.

Table 1. Statistical analysis of the patient characteristics (study group and controls)

Parameter	Study group (n = 46)	Control Group (n = 50)	Test	p
Age			U M–W = –4.12874	
Mean	63.15 years	55.04 years		0.000037
Min–max	37–82 years	45–70 years		
Median	62 years	54 years		
SD	± 10.77 years	± 6.70 years		

BMI Mean Min–max Median SD	 32.12 kg/m^2 19.68–58.59 kg/m^2 31.43 kg/m^2 ± 8.06 kg/m^2	 27.51 kg/m^2 20.55–40.04 kg/m^2 26.25 kg/m^2 ± 4.56 kg/m^2	U M–W = –3.21602	0.0013
Menopausal status Post-menopausal Menstruating	 6 (13.04%) 40 (86.96%)	 30 (60%) 20 (40%)	Chi2Pearson = 8.81567	0.002987
Parity Nulliparas Primiparas Multiparas	 6 (13.04%) 9 (19.57) 31(67.39%)	 4 (8%) 16 (32%) 30 (60%)	Chi2Pearson = 2.213570	0.33062
Concomitant diseases None Cardiovascular Cardiovascular & DM DM	 16 (34.78%) 22 (47.83%) 6 (13.04%) 2 (4.35%)	 27 (54%) 18 (36%) 5 (10%) 0 (0%)	Chi2Pearson = 5.147132	0.16134

SD — standard deviation; BMI — body mass index

Table 2. Clinical-pathological characteristics of the study group

Parameter	Study group II (n = 46)
Histologic type Endometrial endometrioid adenocarcinoma Endometrial serous carcinoma	 42 (91.30%) 4 (8.70%)
Histologic tumor differentiation (grading) G1 G2 G3	 19 (41.30%) 18 (39.13%) 9 (19.57%)
Depth of myometrial infiltration	

< 50%	27 (58.70%)
> 50%	19 (41.30%)
Cervical infiltration	
Yes	14 (30.43%)
No	32 (69.57%)
Serosal and/or adnexal infiltration	
Yes	4 (8.70%)
No	42 (91.30%)
Distant metastases (no lymph node involvement)	
Yes	4 (8.70%)
No	42 (91.30%)
Lymph node metastases (out of 40 lymphadenectomies)	
Yes	4 (10%)
No	36 (90%)
Vascular space infiltration	
Yes	3 (6.52%)
No	43 (93.48%)
Disease advancement according to FIGO	
I	30 (65.22%)
II	8 (17.39%)
III	4 (8.70%)
IV	4 (8.70%)

FIGO — International Federation of Gynaecology and Obstetrics

Table 3. Statistical analysis of serum sL/sP-selectin concentrations in the study group and controls

sL-selectin [ng/mL]	Control group	Study group
Sample size	50	46
Minimum	284	610
Maximum	1000.00	1440
Median	640	912
Mean	589.65	967.28
Standard deviation	206.81	236.17
Skewness coefficient	0.34	0.44
Statistical analysis		

	T test (Cochran and Cox) = –6.08474; p = 0.000001 p < 0.05	
s P-selectin [ng/mL]	Control group	Study group
Sample size	50	46
Minimum	10.40	65.60
Maximum	132	350.00
Median	60.20	138.30
Mean	63.44	171.79
Standard deviation	34.19	90.75
Skewness coefficient	0.39	0.93
Statistical analysis	Mann-Whitney test = –5.07319; p = 0.000000 p < 0.05	

Table 4. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus histologic cancer type

sL-selectin	Histologic cancer type	
	Endometrial endometrioid adenocarcinoma	Endometrial serous carcinoma
Sample size	42	4
Minimum	610.00	656.00
Maximum	1140.00	1214.00
Median	888.00	936.00
Mean	971.11	935.33
Standard deviation	236.90	279.00
Skewness coefficient	0.50	–0.01
Statistical analysis	Mann-Whitney test = –0.148577; p = 0.881888 p > 0.05	
sP-selectin	Histologic cancer type	
	Endometrial endometrioid adenocarcinoma	Endometrial serous carcinoma
Sample size	42	4
Minimum	65.60	99.00
Maximum	349.60	350.00
Median	136.80	167.40
Mean	167.75	205.47
Standard deviation	87.77	129.76
Skewness coefficient	0.96	1.21

Statistical analysis	Mann-Whitney test = –0.557086; p = 0.577469 p > 0.05

Table 5. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus histologic tumor differentiation (grading) of endometrial cancer

sL-selectin	histologic tumor differentiation (grading)		
	G1	G2	G3
Sample size	19	18	9
Minimum	739.00	610.00	656.00
Maximum	1422.00	1440.00	1214.00
Median	914.00	986.00	824.00
Mean	1017.20	968.62	893.86
Standard deviation	230.16	275.38	186.29
Skewness coefficient	0.70	0.22	0.73
Statistical analysis	ANOVA rang Kruskal-Wallis = 1.527614; p = 0.4659 p > 0.05		
sP-selectin	Histologic tumor differentiation (grading)		
	G1	G2	G3
Sample size	19	18	9
Minimum	84.20	65.60	99.00
Maximum	212.20	349.60	350.00
Median	130.50	156.20	167.40
Mean	141.42	170.79	216.74
Standard deviation	43.72	105.58	108.25
Skewness coefficient	0.70	0.76	0.30
Statistical analysis	ANOVA rang Kruskal-Wallis = 1.721003; p = 0.423 p > 0.05		

Table 6. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus the depth of myometrial invasion

sL-selectin	Depth of myometrial invasion	
	< 50%	> 50%
Sample size	27	19
Minimum	610.00	642.00
Maximum	1440.00	1300.00
Median	963.00	816.00
Mean	1009.61	910.83
Standard deviation	239.95	228.72
Skewness coefficient	0.36	0.63
Statistical analysis	T Student test = 1.099459; p = 0.281644 p > 0.05	

sP-selectin	Depth of myometrial invasion	
	< 50%	> 50%
Sample size	27	19
Minimum	72.70	65.60
Maximum	344.40	350.00
Median	143.30	138.30
Mean	162.74	183.85
Standard deviation	78.70	107.20
Skewness coefficient	1.07	0.74
Statistical analysis	Mann-Whitney test = –0.371391; p = 0.710347 p > 0.05	

Table 7. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus cervical infiltration

sL-selectin	Cervical infiltration	
	No	Yes
Sample size	32	14
Minimum	610.00	656.00
Maximum	1440.00	1214.00
Median	914.00	865.00
Mean	977.09	942.75
Standard deviation	241.56	236.22
Skewness coefficient	0.51	0.27
Statistical analysis	T Student test = 0.341845; p = 0.735215 p > 0.05	
sP-selectin	Cervical infiltration	
	No	Yes
Sample size	32	14
Minimum	69.20	65.60
Maximum	234.60	350.00
Median	130.50	191.70
Mean	159.83	201.68
Standard deviation	84.88	103.84
Skewness coefficient	1.29	0.31
Statistical analysis	Mann-Whitney test = –1.06795; p = 0.285544 p > 0.05	

Table 8. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus serosal/adnexal infiltration

sL-selectin	Serosal/adnexal infiltration	
	No	Yes

Sample size	42	4
Minimum	610.00	791.00
Maximum	1440.00	1214.00
Median	936.00	794.00
Mean	971. 39	933.00
Standard deviation	240.11	243.36
Skewness coefficient	0.41	1.73
Statistical analysis	Mann-Whitney test = 0.371442; p = 0.710309 p > 0.05	
sP-selectin	Serosal/adnexal infiltration	
	No	Yes
Sample size	42	4
Minimum	65.60	139.80
Maximum	349.60	350.00
Median	130.60	334.60
Mean	159.43	274.80
Standard deviation	81.46	117.17
Skewness coefficient	1.12	–1.70
Statistical analysis	Mann-Whitney test = –1.81981; p = 0.068788 p > 0.05	

Table 9. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus distant metastasis (not including lymph node metastasis)

sL-selectin	Distant metastasis	
	No	Yes
Sample size	42	4
Minimum	610.00	656.00
Maximum	1440.00	1214.00
Median	936.00	791.00
Mean	976.91	887.00
Standard deviation	234.06	291.12
Skewness coefficient	0.45	1.32
Statistical analysis	Mann-Whitney test = 0.742883; p = 0.457553 p > 0.05	
sP-selectin	Distant metastasis	
	No	Yes
Sample size	42	4
Minimum	65.60	139.80
Maximum	349.60	350.00
Median	130.60	167.40
Mean	166.12	219.07
Standard deviation	88.68	114.23
Skewness coefficient	0.97	1.62
Statistical analysis	Mann-Whitney test = –1.22559; p = 0.220354 p > 0.05	

Table 10. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus lymph node metastasis (out of 40 lymphadenectomies)

sL-selectin	Lymph node metastasis	
	No	Yes
Sample size	36	4
Minimum	610.00	642.00
Maximum	1422.00	1214.00
Median	888.00	1042.00
Mean	953.95	966.00
Standard deviation	221.98	293.48
Skewness coefficient	0.47	–1.09
Statistical analysis	Mann-Whitney test = –0.120427; p = 0.904145 p > 0.05	
sP-selectin	Lymph node metastasis	
	No	Yes
Sample size	36	4
Minimum	65.60	122.60
Maximum	344.40	350.00
Median	130.60	349.60
Mean	159.43	274.07
Standard deviation	83.84	131.17
Skewness coefficient	0.98	–1.73
Statistical analysis	Mann-Whitney test = –1.72583; p = 0.084380 p > 0.05	

Table 11. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus vascular infiltration

sL-selectin	Vascular infiltration	
	No	Yes
Sample size	43	3
Minimum	610.00	656.00
Maximum	1440.00	1214.00
Median	936.00	791.00
Mean	976.91	887.00
Standard deviation	234.06	291.12
Skewness coefficient	0.45	1.32
Statistical analysis	Mann-Whitney test (Z) = 0.742883; p = 0.457553 p > 0.05	
sP-selectin	Vascular infiltration	
	No	Yes
Sample size	43	3
Minimum	65.60	139.80
Maximum	349.60	350.00

Median	130.60	167.40
Mean	166.12	219.07
Standard deviation	88.67	114.23
Skewness coefficient	0.97	1.62
Statistical analysis	Mann-Whitney test (Z) = –1.22559; p = 0.220354 p > 0.05	

Table 12. Statistical analysis of serum sL/sP-selectin concentrations in the study group versus disease advancement [International Federation of Gynaecology and Obstetrics (FIGO)]

sL-selectin	Endometrial cancer stage (FIGO)			
	I	II	III	IV
Sample size	30	8	4	4
Minimum	610.00	729.00	642.00	656.00
Maximum	1440.00	1214.00	1042.00	1214.00
Median	914.00	1072.00	794.00	791.00
Mean	992.10	1021.75	826.00	887.00
Standard deviation	241.09	234.31	201.91	291.12
Skewness coefficient	0.55	–0.63	0.70	1.32
Statistical analysis	ANOVA rang Kruskal-Wallis = 2.129175; p = 0.546 p > 0.05			
sP-selectin	Endometrial cancer stage (FIGO)			
	I	II	III	IV
Sample size	30	8	4	4
Minimum	69.20	65.60	122.60	139.80
Maximum	344.40	241.00	349.60	350.00
Median	130.50	157.50	334.60	167.40
Mean	151.36	155.40	268.93	219.07
Standard deviation	76.00	86.11	126.95	114.23
Skewness coefficient	1.39	-0.06	–1.71	1.62
Statistical analysis	ANOVA rang Kruskal-Wallis = 4.086207; p = 0.2523 p > 0.05			

Conflict of interest

All authors declare no conflict of interest.

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