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Selected imaging methods to assess treatment results in ovarian cancer – ultrasound examination and computed tomography versus "second-look" laparotomy findings

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Study aim. The aim of the study was to establish the correlations between US and CT (analyzed separately and in combination) and relaparotomy findings both in relation to whole abdomen and pelvis examination and to particular anatomical localizations.
Material and methods. A retrospective analysis of 102 ovarian cancer patients was performed in order to examine the accuracy of ultrasound examination (US) and computed tomography (CT) for the assessment of treatment results before „second-look laparotomy" and to evaluate the correlations between imaging and relaparotomy findings.
Results. Statistically significant correlation was found between US and CT (analyzed separately and in combination) and relaparotomy findings both in relation to whole abdomen and pelvis examination and to particular anatomical localizations. In subgroup 1 (54 patients after radical tumor excision, radical hysterectomy and partial omentectomy) CT results and combined CT/US results were statistically significantly more accurate than US results in relation to pathologic changes in the parenchymal organs and in the assessment of the presence of intraperitoneal fluid. In subgroup 2 (48 patients after debulking or exploratory surgery) CT and US/CT in combination were statistically significantly superior, as compared to US alone for examination of pelvic structures and combined CT/US – statistically superior when compared to US as far as parenchymal organs of the abdomen are concerned.
In both subgroups there was no statistically significant difference between combined imaging results and CT alone for any anatomic location but combined CT/US results for the whole abdomen and pelvis were more accurate than the results of each modality performed separately – achieving statistical significance.
Conclusions. US and CT performed before „second-look" laparotomy have high accuracy, which renders them important elements of the ovarian cancer treatment strategy. None of the evaluated methods appeared superior over the other when used separately although the CT results appeared slightly more accurate. A combination of both methods allows obtaining more accurate results than diagnostics based only on one of them. Nevertheless, it is impossible to eliminate "second-look" laparotomy from the procedures controlling the results of the ovarian cancer treatment due to the possibility of false negative imaging results.

Wybrane metody diagnostyki obrazowej w ocenie efektów leczenia raka jajnika – ultrasonografia i tomografia komputerowa a weryfikacja w relaparotomii

Cel. Celem pracy jest ustalenie skuteczności ultrasonografii (USG) i tomografii komputerowej (KT) dla oceny wyników leczenia przed planowanym zabiegiem typu „second-look laparotomy" oraz ocena korelacji metod diagnostyki obrazowej i relaparotomii.
Materiał i metody. Przeprowadzono retrospektywną analizę grupy 102 chorych na raka jajnika, oceniając korelację pomiędzy USG i KT, analizowanymi pojedynczo i łącznie, a wynikami relaparotomii, zarówno w odniesieniu do badania całej jamy brzusznej i miednicy, jak i w stosunku do poszczególnych lokalizacji anatomicznych.
Wyniki. Wykazano znamienną statystycznie korelację pomiędzy USG i KT, analizowanymi pojedynczo i łącznie, a wynikami relaparotomii, zarówno w odniesieniu do badania całej jamy brzusznej i miednicy, jak i w stosunku do poszczególnych lokalizacji anatomicznych.

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W podgrupie 1 (54 pacjentki, u których wykonano całkowite usunięcie zmian nowotworowych wraz z narządem rodnym i częścią sieci większej) wyniki KT oraz USG i KT łącznie były statystycznie znamiennie trafniejsze od USG w odniesieniu do zmian w narządach miąższowych jamy brzusznej i oceny obecności płynu w jamie otrzewnej. W podgrupie 2 (48 pacjentek po zabiegu nieradykalnym lub zwiadowczym) stwierdzono znamienną statystycznie wyższość KT oraz sumarycznego wyniku KT i USG w porównaniu do USG w ocenie zmian w strukturach miednicy mniejszej, a także sumarycznego wyniku KT i USG w porównaniu do USG w ocenie zmian w narządach miąższowych jamy brzusznej. W obu podgrupach nie stwierdzono istotnej statystycznie różnicy między sumarycznym wynikiem badań obrazowych a KT dla żadnej z lokalizacji anatomicznych, wykazano natomiast znamienną statystycznie dokładność sumarycznego wyniku KT i USG całej jamy brzusznej oraz miednicy mniejszej w porównaniu do wyników tych badań wykonywanych odrębnie.
Wnioski. USG i KT poprzedzające operację typu „second-look" cechowały się dużą trafnością diagnostyczną, co pozwala uznać je za istotny element strategii postępowania w leczeniu raka jajnika. Nie wykazano wyższości żadnego z badań obrazowych stosowanych samodzielnie, choć nieco trafniejsze wyniki uzyskiwano przy zastosowaniu KT. Połączenie obu metod obrazowania pozwala uzyskać trafniejsze wyniki niż ocena w oparciu tylko o jedną z nich. Obecność fałszywie ujemnych wyników badań obrazowych uniemożliwia całkowite wyeliminowanie operacji „second-look" z procedur kontrolujących efekty leczenia raka jajnika.

Key words: ultrasound examination, computed tomography, „second-look", ovarian cancer
Słowa kluczowe: ultrasonografia, tomografia komputerowa, „*second-look*", rak jajnika

Introduction

"Second-look" laparotomy is the basic method of assessing treatment results in patients with ovarian cancer [1-7]. The actual efficacy of this surgical procedure is difficult to establish because of a lack of prospective studies and therefore its routine application for the verification of treatment results is still a matter of discussion [1, 2, 4-24]. Recently we have been observing an increase of the value of imaging diagnostic techniques for the assessment of treatment results [15, 21, 23]. Ultrasound examination (US) and the two more accurate methods – computed tomography (CT) and magnetic resonance imaging (MRI) allow to evaluate and verify pathologic findings with the aid of controlled fine needle biopsy, although they fail in sensitivity in cases of micronodular dissemination [25-35].

The aim of this study was to verify the applicability of US and CT in the evaluation of the effects of treatment in patients with ovarian cancer and to evaluate the correlation between the results obtained from US and CT and during „second-look" laparotomy.

Method

The study was based on a retrospective analysis of 102 patients with ovarian cancer treated at the Gynecological Clinic of the Maria Skłodowska-Curie Memorial Cancer Center and Institute of Oncology in Cracow between the years 1991 and 2000. The patients were divided into two groups depending on the type of initial surgical procedure. Subgroup 1 consisted of 54 patients (52.94%) who had undergone radical tumour resection with radical hysterectomy and partial omentectomy. Subgroup 2 consisted of 48 patients (47.06%) who had undergone partial tumour resection, without the reproductive organs, or who underwent biopsy only.

The correlation of the results of US and CT scans with the results of „second-look" laparotomies was evaluated with Spearman's rank order correlations test. The analysis of differences was performed with the aid of a correlation coefficients comparison test; the level of statistical significance was set at $p \leq 0.05$.

Mean patient age was 51 years, range 19-70 years. All patients underwent surgery, followed by postoperative chemotherapy.

Before the „second-look" laparotomy all patients underwent US and CT of the abdominal cavity and of the pelvis. US was performed with the Toshiba SAL38AS equipped with a 3.5 MHz sector probe and a 4MHz linear probe or with the Logiq 500™ Pro Series with a convex 3.5 MHz probe and adjustable frequency of 2.5-4 MHz. CT was performed on the Sytec 3000i with single scanning (scan time – 1.8 sec.; table repositioning –10 mm) before and after the administration of contrast. The CT scan covered the area between the diaphragm and the pubic symphysis. The time lapse between the diagnostic procedure and the „second-look" laparotomy was 4-14 days in case of US and 3-19 days in case of CT.

During the diagnostic imaging examinations I analysed all abnormalities within the structures of the pelvis, the retroperitoneal lymph nodes, the omentum, between the intestines and on the peritoneum, and within the parenchymal organs of the abdomen. I also assessed the presence of intraperitoneal fluid. The results obtained in the course of imaging diagnostics were verified during „second-look" laparotomy and confronted with the results of histopathological analysis of the intraoperative material.

Results

The analysis of US and CT results was performed separately in both subgroups of patients in relation to pathologic findings located in specific anatomical localizations and in relation to pathologic findings found within the entire abdominal cavity and pelvis. A similar analysis was performed for the combined results of both imaging methods.

The diagnostic accuracy of the imaging methods measured as their sensitivity, specificity, predictive value and efficacy was evaluated.

The results are presented in Table I and II.

Within the two subgroups I analysed the correlation of results of imaging techniques (both alone, and as a combined analysis) depending upon the localisation of pathologic changes and the assessment of the whole examination, as compared to the results obtained during

Table I. US and CT performance parameters according to particular anatomic localizations in subgroup I

	Ultrasound examination (US)					Computed tomography (CT)					Combined US+CT results				
	Sensitivity (%)	Specificity (%)	Positive predictive value PPV (%)	Negative predictive value NPV (%)	Accuracy (%)	Sensitivity (%)	Specificity (%)	Positive predictive value PPV (%)	Negative predictive value NPV (%)	Accuracy (%)	Sensitivity (%)	Specificity (%)	Positive predictive value PPV (%)	Negative predictive value NPV (%)	Accuracy (%)
Pathologic changes in pelvic structures	71.43	97.87	83.33	95.83	94.44	85.71	95.74	75.00	97.83	94.44	85.71	97.87	85.71	97.87	96.30
Pathologic changes in retroperitoneal lymph nodes	66.67	98.04	66.67	98.04	96.30	66.67	96.08	50.00	98.00	94.44	66.67	98.04	66.67	98.04	96.30
Omental, peritoneal and mesenteric pathologic changes	35.71	97.50	83.33	81.25	81.48	50.00	95.00	77.78	84.44	83.33	50.00	97.50	87.50	84.78	85.19
Pathologic changes in parenchymatous organs	50.00	98.00	66.67	96.08	94.44	75.00	98.00	75.00	98.00	96.30	75.00	98.00	75.00	98.00	96.30
Presence of peritoneal fluid	66.67	98.04	66.67	98.04	96.30	33.33	98.04	50.00	96.15	94.44	66.67	98.04	66.67	98.04	96.30
The assessment of the whole examination	63.16	88.57	75.00	81.58	79.63	73.68	91.43	82.35	86.49	85.19	78.95	91.43	83.33	88.89	87.04

Table II. US and CT performance parameters according to particular anatomic localizations in the subgroup II

	Ultrasound examination (US)					Computed tomography (CT)					Combined US+CT results				
	Sensitivity (%)	Specificity (%)	Positive predictive value PPV (%)	Negative predictive value NPV (%)	Accuracy (%)	Sensitivity (%)	Specificity (%)	Positive predictive value PPV (%)	Negative predictive value NPV (%)	Accuracy (%)	Sensitivity (%)	Specificity (%)	Positive predictive value PPV (%)	Negative predictive value NPV (%)	Accuracy (%)
Pathologic changes in pelvic structures	88.57	76.92	91.18	71.43	85.42	97.14	84.62	94.44	91.67	93.75	97.14	92.31	97.14	92.31	95.83
Pathologic changes in retroperitoneal lymph nodes	33.33	97.78	50.00	95.65	93.75	66.67	97.78	66.67	97.78	95.83	66.67	97.78	66.67	97.78	95.83
Omental, peritoneal and mesenteric pathologic changes	33.33	86.67	84.62	37.14	50.00	60.61	93.33	95.24	51.85	70.83	63.64	93.33	95.45	53.85	72.92
Pathologic changes in parenchymatous organs	66.67	97.62	80.00	95.35	93.75	83.33	95.24	71.43	97.56	93.75	83.33	97.62	83.33	97.62	95.83
Presence of peritoneal fluid	54.55	97.30	85.71	87.80	87.50	72.73	97.30	88.89	92.31	91.67	81.82	97.30	90.00	94.74	93.75
The assessment of the whole examination	86.84	60.00	89.19	54.55	81.25	97.37	70.00	92.50	87.50	91.67	97.37	80.00	94.87	88.89	93.75

„second-look" laparotomy. The results of this analysis are presented in Table III.

There exists a statistically significant correlation between the results of imaging diagnostic techniques (both alone and combined) and the results of „second-look" laparotomy. This correlation was observed for all anatomical localizations in both subgroups of patients.

The results of an analysis of the differences between CT and US results and the combined results of both the imaging techniques as relating to the anatomical localization of the pathologic findings are presented in Table IV.

In subgroup 1 there was a statistically significantly higher predictive accuracy of CT, as compared to US, in relation to pathologic findings within the parenchymal organs of the abdominal cavity and to the presence of intraperitoneal fluid. I also observed statistically significantly higher accuracy of the combined results of the two methods as compared to the results of US only.

In subgroup 2 there was a statistically significantly higher predictive accuracy of CT as compared to US in relation to pathologic findings within the structures of the pelvis. The combined results of the two methods were statistically significantly better than the results of US only, as related to pathologic findings within the pelvis and within the parenchymal organs of the abdominal cavity.

When analyzing the results of CT and US of the entire abdominal cavity and the pelvis I have found a statistically significantly higher accuracy of the combined results of the two methods as compared to the results of CT and US performed separately in both subgroups of patients.

In 5 cases the results of the imaging studies were falsely negative – in 4 patients from subgroup 1 in regard to pathologic findings within the omentum and in 1 patient from subgroup 2 in regard to pathologic findings within the pelvis and the omentum. In 10 cases the imaging diagnostic techniques provided false positive results – i.e. in 6 patients from subgroup 1 and in 4 patients from subgroup 2.

Discussion

In view of the varied opinions regarding the routine use of „second-look" laparotomy as a part of ovarian cancer treatment the problem of presenting an alternative, and also adequately accurate method of assessing treatment results is becoming an important issue. This study has allowed to analyse the diagnostic accuracy of CT and US, the two most accessible methods of diagnostic imaging. It has shown statistically significant correlation between the results of both these techniques and the results obtained during „second-look" laparotomy in regard to all the analysed anatomical localizations. Such results were obtained both among patients who had undergone radical tumour resection and radical hysterectomy with partial omentectomy (subgroup 1) and among those, who had undergone only partial tumour resection without hysterectomy, or biopsy only (subgroup 2).

As compared to the results reported by other authors I have found US to possess relatively high sensitivity and efficacy, however its specificity was somewhat lower than in a number of literature reports [31, 36-39]. These differences may arise from the retrospective character of the analysis. It seems worth to stress the relatively large differences between the specificity of the methods and the indexes of predictive negative value between the two subgroups of patients. Such a phenomenon may arise from the fact that in patients who had not undergone total tumor resection the conditions for imaging diagnostics are much poorer due to difficulties in patient preparation and problems with discerning tumour masses from the poorly mobile intestines and remnants of the reproductive organs. Other authors report similar problems associated with US [40].

In the examined cases the CT results were found to be somewhat more accurate than the US results. Similar observations have been reported by Garcia Enguidanos et al. [37]. The results obtained in my study were, in general, similar or slightly better than those reported by other authors. One cannot fail to notice the higher sensitivity and efficacy of CT (observed in both patient subgroups) as compared to the results of other authors, and its slightly lower specificity observed in patients from subgroup 2 [28, 35, 37, 41]. The sensitivity observed in my material was five times as high as that reported by Lund et al, while efficacy and negative predictive value – twice as high [38].

Only a few studies report the evaluation of the diagnostic efficacy of both US and CT [36-38, 42] while I have found only one paper describing an attempt to assess the value of combining the results of these two methods [38].

Sanders et al. have compared the results of CT and US and shown a similar diagnostic accuracy of the two methods (81%); in case of CT sensitivity was 96%, in case of US – 91% [42]. Buist et al. report identical test measurements of USG and CT when interpreted by one of the two evaluating radiologists: sensitivity was 56% while diagnostic accuracy – 58% (the second radiologist achieved 100% for both parameters) [36]. Garcia Enguidanos et al. have proven similar specificity of the two methods, the other test measurements were significantly worse in the case of US, as compared to CT [37]. Lund et al. have compared the results of US, CT and the combination of these two methods revealing a strikingly low sensitivity of these methods – 14% for US, 11% for CT and 12% for the combination of the two [38]. In the present study sensitivity was much higher – 63.16% for US, 73.68% for CT and 78.95% for the combination of the two in subgroup 1, and 86.84%; 97.37% and 97.37%, respectively, in subgroup 2. I also found slightly higher diagnostic accuracy of both the methods when taken separately and combined, and their slightly lower specificity, as compared to the paper cited above. The present analysis has shown that in both subgroups of

Table III. Correlation between imaging methods and "second-look" laparotomy findings in both subgroups

	Ultrasound examination				Computed tomography				Combined US + CT			
	Subgroup I		Subgroup II		Subgroup I		Subgroup II		Subgroup I		Subgroup II	
	R Spearmana	p	R Spearmana	p	R Spearmana	p	R Spearmana	p	R Spearmana	P	R Spearmana	p
Pathologic changes in pelvic structures	0.8233	0.0000	0.5537	0.0001	0.8419	0.0000	0.7485	0.0000	0.9017	0.0000	0.7742	0.0000
Pathologic changes in retroperitoneal lymph nodes	0.8193	0.0000	0.6612	0.0000	0.8462	0.0000	0.7994	0.0000	0.9121	0.0000	0.8105	0.0000
Omental, peritoneal and mesenteric pathologic changes	0.6262	0.0000	0.3818	0.0074	0.6679	0.0000	0.6058	0.0000	0.7379	0.0000	0.6122	0.0000
Pathologic changes in parenchymatous organs	0.7908	0.0000	0.8576	0.0000	0.9991	0.0000	0.9086	0.0000	0.9991	0.0000	0.9500	0.0000
Presence of peritoneal fluid	0.8456	0.0000	0.7668	0.0000	0.8809	0.0000	0.7864	0.0000	0.8809	0.0000	0.8146	0.0000
The assessment of the whole examination	0.7076	0.0000	0.6943	0.0000	0.7617	0.0000	0.7359	0.0000	0.8600	0.0000	0.8257	0.0000

Table IV. Differences between imaging methods according to particular anatomic localizations in both subgroups

	Computed tomography (CT) vs ultrasound examination (US) (p)		Ultrasound examination + computed tomography (US+CT) vs ultrasound examination (US) (p)		Ultrasound examination + computed tomography (US+CT) vs computed tomography (CT) (p)	
	Subgroup I	Subgroup II	Subgroup I	Subgroup II	Subgroup I	Subgroup II
Pathologic changes in pelvic structures	0.4044	0.0350	0.1143	0.0266	0.2032	0.8101
Pathologic changes in retroperitoneal lymph nodes	0.7319	0.1891	0.0545	0.1186	0.1364	0.8814
Omental, peritoneal and mesenteric pathologic changes	0.9354	0.1352	0.2898	0.1445	0.4846	0.9616
Pathologic changes in parenchymatous organs	0.0000	0.3984	0.0000	0.0109	1.0000	0.1419
Presence of peritoneal fluid	0.0169	0.5943	0.0169	0.5451	1.0000	0.7100
The assessment of the whole examination	0.0971	0.1871	0.0000	0.0006	0.0008	0.0115

patients the results of the combination of two methods were statistically significantly more accurate than the results of the methods when taken separately.

Apart from an analysis of the complex results of US and CT I have also performed an analysis of the results in regard to the following anatomical localizations – structures of the pelvis, the omentum, the peritoneum and the mesentery, retroperitoneal lymph nodes, parenchymal organs of the abdominal cavity and the presence of intraperitoneal fluid.

Pathologic findings within the structures of the pelvis

Within this localization the US results were slightly poorer than the results reported by Khan et al. (sensitivity – 94%; specificity – 92%; efficacy – 93%) [31]. Pussell et al. report its sensitivity for the examination of pathologic findings within the pelvis at a level of 83% [40].

The CT test measurements were similar or better than those reported by other authors. Silverman et al. report sensitivity at the level of 85% and specificity at 97% [35]. The CT results are more accurate than the US results in the case of pathologic findings found within the pelvis, although they are not free of error. Goldhirsch et al. report a 63% ratio of false negative results [43], while Megibow et al. stress the difficulties in the evaluation of residual malignant masses located along the floor of the pelvis and in the vicinity of the infundibular ligament [32].

In the course of this study the analysis of subgroup 2 has revealed statistically significantly higher predictive

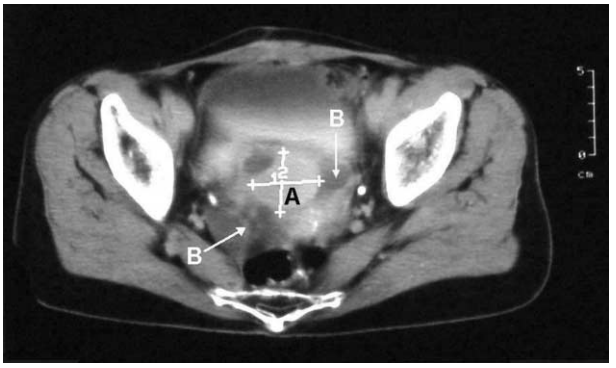

Figure 1. Complex cystic and solid masses enhancing after contrast administration (A) modeling posterior wall of urinary bladder, increased density of surrounding fatty tissue (B)

accuracy of CT and combined CT and US as compared to US alone in relation to pathologic findings found within the structures of the pelvis.

Pathologic findings within the omentum, the peritoneum and between intestinal loops

The relatively low sensitivity of both US and CT for the evaluation of pathologic findings within the omentum, between intestine loops and on the peritoneum poses a significant problem. The results of this study are, in the case of US, better than those reported by other authors, while in the case of CT they correlate with those reported in literature. Wicks et al. have shown the sensitivity of US to be 18% for pathologic findings within the omentum, 16% for pathologic findings within the peritoneum and 37% for pathologic findings within the mesentery [39]. Pussell et al. report a 6% sensitivity of US for the evaluation of intraperitoneal pathologic findings [40]; Low et al. – a 51% sensitivity of CT within the same localization and Buy et al. – a 63% sensitivity [44, 45].

These relatively low values of the test parameters arise from the fact that the evaluation of the omentum, the peritoneum and the intestinal loops poses a significant clinical problem, which has often been widely discussed in numerous literature reports.

Using CT De Rosa et al. have managed to localize only 10% of omental and intraperitoneal foci of dissemination below 1 cm in diameter; and only 40% of larger pathologic findings [28]. Goldhirsch et al. report a high ratio of false negative results: 100% in case of pathologic findings within the mesentery, 89% in case of peritoneal pathologic findings and 50% in case of pathologic findings within the omentum [43]. Lund et al. stress the fact that in their study group both US and CT had revealed only 36% of metastatic lesions below 2 cm in diameter [38]. According to Buy et al. the efficacy of CT does not depend on the size of the lesions but rather on their localization and the co-existence of intraperitoneal fluid [44]. Long, flat infiltrations, reticular infiltrations and lesions with unclear contours cause greatest diagnostic problems [32, 39], as does differentiation between malignant remnants and iatrogenic fibrosis or peritoneal reactions [32]. One of the assets of CT is the possibility to examine the area directly below the diaphragm, which is difficult to evaluate during laparotomy performed from the median approach – the most popular approach in the case of ovarian cancer – and which is a common early site of ovarian cancer metastases [44].

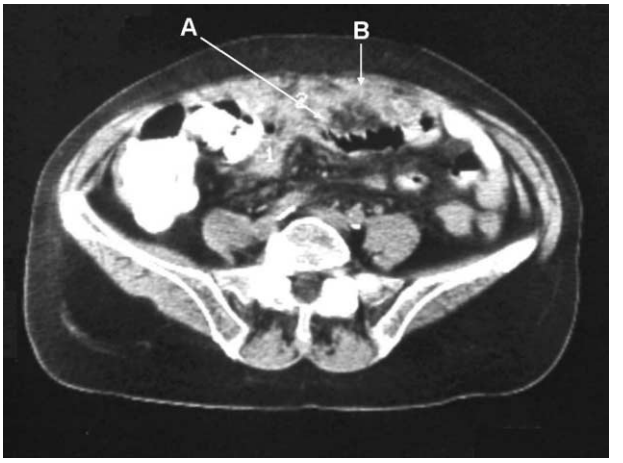

Figure 2. Hypodense metastases between bowel loops (A), infiltration of omental fat and peritoneal surface (omental cake) (B)

Pathologic findings within the retroperitoneal lymph nodes

The parameters for CT and US in the course of diagnostics of retroperitoneal lymph nodes were similar – only the sensitivity of US was found to be twice as low among patients from subgroup 2. Such a result may arise from the misinterpretation of grouped lymph nodes for intraperitoneal residual masses in patients who had undergone non-radical surgery. The results achieved with US are, even in subgroup 2, better than those reported by other authors. Wicks et al. report a 29% sensitivity of US for the examination of retroperitoneal lymph nodes [39]. In the study by Goldhirsch et al. CT provided accurate evaluation of the retroperitoneal space in 80% of cases – provided the diameter of the lesions exceeded 1 cm [43]. Brenner et al. report a 63% accuracy of CT for the evaluation of retroperitoneal lymph nodes [25].

Figure 3. Enlargement of periaortal lymph nodes (A)

Pathologic findings within the parenchymal organs of the abdominal cavity

The great value of imaging diagnostic methods arises from their ability to discern metastases placed centrally within the parenchymal organs of the abdominal cavity. Such pathologic findings are difficult to evaluate in the course of laparotomy [28]. Besides, both US and CT allows to verify these lesions with the aid of guided fine needle biopsy [38].

Apart from the slightly lower sensitivity all other parameters observed in the course of this study resemble those reported by other authors. The evaluation of hepatic lesions reported by Khan et al. had a sensitivity of 63%, a specificity of 97% and a test efficacy of 91% [31]. Pussell et al. report a 67% sensitivity for pathologic findings in this localisation, while Tempany et al. – sensitivity of 57% and specificity of 98% [40, 46]. In view of these findings one wonders at the low sensitivity reported by Buist et al., i.e. 33% [36].

When CT was used to evaluate the pathologic findings within the parenchymal organs of the abdominal cavity the sensitivity was found to be 75% in subgroup 1 and 83.33% in subgroup 2, while sensitivity was 98% and 95.24%, respectively and efficacy – 96.3% and 93.75, respectively. The sensitivity observed in this study resembles that reported by other authors, as do the other test measurements. Clarke-Pearson et al. have managed to achieve 100% sensitivity with 98% specificity [27], while Tempany et al., in the course of the studies with the Radiological Diagnostic Oncology Group report a 49% sensitivity and a 96% specificity in case of hepatic lesions [46]. Buist et al. report the low sensitivity of CT of the liver – lying within the 0-33% range, depending upon the person evaluating the scan [36].

In the course of this study the statistically significant higher predictive accuracy of CT was observed in both subgroups of patients, just as in the case of the combined results of US and CT, as compared to US alone in relation to pathologic findings within the parenchymal organs of the abdominal cavity.

Figure 4. Multiple liver metastases (A)

Presence of intraperitoneal fluid

US is a relatively reliable method of evaluating the presence of intraperitoneal fluid. Khan et al. have found the sensitivity of US to be 87%, with a specificity of 99% and an efficacy of 97% [31]. Wicks et al. report a sensitivity of 92% [39]. In the present study the evaluation of the presence of intraperitoneal fluid has shown a slightly lower sensitivity, with comparable specificity and efficacy in subgroup 1 (96.3%), while its efficacy in subgroup 2 was also slightly lower (87.5%).

The results achieved for CT were similar, apart from the unexpected twice as low sensitivity observed in subgroup 1 (33.33%). To compare: Brenner et al. report a 75% sensitivity and a 98% specificity of CT for the examination of ascites [25]. On the other hand, in an analysis of own material Lund et al. point out that ascites was observed on CT scans only in 1 out of 6 cases confirmed surgically, while US failed to discern it in all

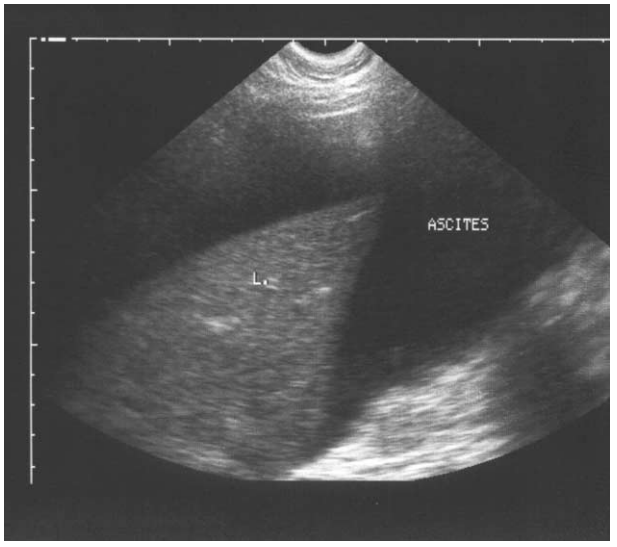

Figure 5. Ascitic fluid (ASCITES) around the liver (L)

cases [38]. According to the paper by Bristow et al. the sensitivity of CT in patients with significant ascites was 38% [47].

Figure 6. Metastatic tumor (A) and ascitic fluid between bowel loops (B)

In the present study I have discerned the statistically significantly higher predictive accuracy of CT alone and combined CT and US, as compared to US alone in regard to the presence of intraperitoneal fluid.

Due to the likelihood of achieving false negative results neither US nor CT may replace „second-look" laparotomy [25, 27, 32, 39, 41, 43, 48].

Particular difficulties are encountered when the diameter of the lesions is under 2 cm and in cases of foci of dissemination and microdissemination within the mesentery and the peritoneum [39, 48], although some authors also report rather unexpected difficulties in the evaluation of lesions over 3 cm in diameter [25]. Regarding lymph nodes Clarke-Pearson et al. report finding histologically confirmed metastases in some 80% of nodes 1cm or less in diameter and stress the misleading aspect of the size of the node as a criterion [27].

The use of appropriate techniques and algorithms may increase the precision of the examinations. Megibow et al. suggest the use of dynamic scans of the liver and the retroperitoneal space after intravenous contrast administration and the examination of the pelvis with the use of 5 mm scans, having previously contrasted the colon with air. Very careful scrutiny should be performed at the floor of the pelvis, the round ligaments and the pouch of Douglas. This method should help to discern pathologic findings placed beneath the diaphragm, on the intestinal loops and within the muscles of the floor of the pelvis and should also allow for a more precise examination of the fatty tissue [32]. Some authors suggest that CT should be performed after intrapreritoneal application of an appropriate contrast [29, 30, 49, 50], however in view of the invasive aspect of such a method one should rather recommend such imaging techniques as MRI or PET [3, 51-53].

Both the data gathered in the course of the present study, and that published by other authors shows that neither CT nor US, whether as a sole procedure, or combined, cannot, in a majority of cases, replace „second-look" laparotomy. Due to the difficulties in visualizing microscopic lesions both these methods fail to identify patients who may be positively pronounced free of disease. Nevertheless they allow to positively identify patients with doubtless signs of disease and, in such cases, allow for making therapeutical decisions without the need for „second-look" laparotomy [27, 32, 54].

It is necessary to stress that imaging diagnostics should be performed before „second-look" laparotomy, as they may provide the surgeons with valuable information concerning the presence of pathologic findings deep within the liver or directly below the crura of the diaphragm – i.e. at sites which are difficult to evaluate during laparotomy – and thus, indirectly, improve the results of treatment.

Conclusions

Basing upon the performed analyses the following conclusions may be drawn:

1. CT and USG performed before „second-look" laparotomy had high diagnostic accuracy both in the subgroup of patients who had undergone radical tumour resection and radical hysterectomy with partial omentectomy and in the subgroup of patients who underwent partial tumour resection without hysterectomy or biopsy only. Therefore both the methods may be considered an important element of treatment strategy in ovarian cancer patients.
2. Neither method was found to be statistically significantly superior for the analysis of the entire abdominal cavity and the pelvis in both the analyzed patient subgroups, although the results achieved with CT were slightly more accurate.
3. The combination of both methods for the analysis of the entire abdomen and the pelvis allows to achieve statistically significantly more accurate results in both

subgroups of patients, as compared to the evaluation with only one method.

4. Although false negative results of diagnostic imaging were very few, yet they pose a strong argument against omitting „second-look" laparotomy from the list of procedures necessary to control the effects of treatment in patients with ovarian cancer
5. Before the patients qualify for „second-look" laparotomy they should undergo imaging diagnostics examination, which will allow to identify patients with undoubtable signs of malignant masses, in whose case therapeutic decisions may be made without further surgical intervention. Imaging diagnostics results may supply important information concerning pathologic findings located in areas, which are difficult to assess in the course of laparotomy.

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