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ORIGINAL ARTICLE

Diagnostic value of carbohydrate antigen 72-4 combined with carbohydrate antigen 15.3 in ovarian cancer, cervical cancer and endometrial cancer

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Summary

Purpose: *This study was designed to explore the value of carbohydrate antigen 72-4 (CA72-4) combined with carbohydrate antigen 15-3 (CA153) in diagnosing gynecologic malignancies.*

Methods: *64 patients with ovarian cancer admitted to our hospital from February 2014 to February 2016 comprised the group A; 52 cases of cervical cancer were regarded as group B; 46 cases of endometrial cancer comprised the group C; and 150 cases of healthy women were considered as a control group. The CA72-4 and CA15.3 levels in serum of each group were detected, and receiver operating characteristics (ROC) curve was used to analyze the diagnostic value of CA72-4 and CA15.3 in ovarian, cervical, as well as in endometrial cancer.*

Results: *CA72-4 and CA15.3 increased dramatically in cancer patients ($p<0.001$). CA15.3 in group C was higher than in groups A and B ($p<0.05$). Joint diagnosis of the two had good sensitivity, specificity and area under the curve (AUC) for ovarian, cervical as well as for endometrial cancer ($p<0.001$). CA72-4 and CA15.3 were closely related to the occurrence of gynecologic malignancies ($p<0.001$). The results of follow-up revealed that CA72-4 had a higher value in predicting the death of ovarian cancer patients within 3 years, while CA15.3 had a better effect in predicting the death of ovarian and cervical cancer ($p<0.05$).*

Conclusion: *CA72-4 and CA15.3 were dramatically higher in ovarian, cervical and endometrial cancer among gynecologic malignancies. Joint detection of the two had better diagnostic value for ovarian and cervical cancer.*

Key words: *CA72-4, CA15.3, ovarian cancer, cervical cancer, endometrial cancer, diagnosis*

Introduction

At present, malignancies have gradually become the second primary diseases after cardiovascular diseases that endangers human life and health, and their morbidity in clinical practice is increasing [1]. Among all tumors, gynecologic malignancies are the most common type, with a very high morbidity [2]. Ovarian cancer, endometrial cancer and cervical cancer are the main gynecologic malignancies, which are frequent in middle and aged people [3,4]. In recent years, an increasing number of studies have shown that their morbidity is on the rise year by year, and the patient groups are markedly getting younger and younger [5,6]. At the moment, the pathogenesis of ovarian, endometrial and cervical cancer and other diseases has not been clearly defined, and the early diagnosis of gynecologic malignancies has been in difficult times [7]. Moreover, gynecologic malignancies usually have no significant or special clinical symptoms in their early stage. Once the disease is detected in the middle and late stages, the difficulty of treatment greatly increases [8]. The main method of

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clinical treatment for gynecologic malignancies is still surgery or combination of radiotherapy and chemotherapy, but the effect is not ideal for patients with advanced tumors [9,10]. According to statistics, their survival rate after pelvic exenteration is only 40.0%, and the risk of other gynecological diseases is greatly elevated [11,12]. Therefore, clinical research has been devoted to finding new diagnostic and treatment methods for gynecologic malignancies.

The study of tumor markers has long been a hot topic clinically. Although traditional tumor markers such as CEA and CA19.9 have good sensitivity in tumors, they are generally not specific enough to effectively and accurately judge the type and progress of tumors [13]. Hence, in order to better differentiate and diagnose tumors, clinical diagnosis and analysis can be carried out through joint detection of multiple tumor markers [14]. Among them, CA72-4 is a tumor-associated glycoprotein assessed by monoclonal antibodies B72-3 and CC49, which have been proved to be abnormally expressed in a number of digestive tract diseases [15,16]. CA15.3, a variant of glycoprotein on the surface of breast epithelial cells, is most commonly used for diagnosis and monitoring of breast cancer, but lacks specificity [17]. To further understand the application of CA72-4 and CA15.3 in gynecological malignancies, this study aimed to provide reference and guidance for future clinical gynecologic diagnosis and treatment of tumor patients by analyzing the diagnostic value of CA72-4 combined with CA15.3 for various gynecologic malignancies.

Methods

General data

A total of 162 patients with gynecologic malignancies and 150 healthy women undergoing physical examination admitted from February 2014 to February 2016 in our hospital were selected as the research population. Among them, 64 cases of ovarian cancer formed the group A, 52 cases of cervical cancer formed the group B, 46 cases of endometrial cancer formed the group C, and healthy women undergoing physical examination formed the control group. There were no remarkable differences in general data such as age and body mass index (BMI) between the four groups ($p>0.05$). This study was approved by the Ethics Committee of our hospital, and all the above individuals signed an informed consent form either themselves or their immediate family members.

Inclusion and exclusion criteria

Inclusion criteria were as follows: symptoms attributed to clinical manifestations of tumor; malignancies (ovarian, endometrial and cervical cancer) confirmed after biopsy by the pathology department of our hospital; patients classified according to TNM staging guidelines for tumors; patients with complete data; patients aged from 20 to 70 years; patients without any antibiotic treatment within 3 months before admission; patients who agreed to cooperate with the medical staff and participate in the investigation.

Exclusion criteria were as follows: patients with multiple tumors, other cardiovascular and cerebrovascular diseases, infectious diseases, autoimmune diseases and mental diseases; patients with liver and renal insufficiency; pregnant and lactating women; patients with physical disabilities unable to take care of themselves, staying long in bed; transfer patients in the middle of treatment; patients with contraindications to surgery and drug allergy.

Inclusion and exclusion criteria in the control group were as follows: healthy people undergoing physical examination in our hospital; normal physical examination results; no previous major medical history; female patients agreed to cooperate and participate in the investigation of medical staff in our hospital.

Methods

After admission, 6 mL of fasting venous blood was drawn from the patients. Then, after standing 30 min at room temperature, blood was centrifuged for 10 min (4000 rpm/min) to obtain the serum, which was put in a refrigerator at -80° for later testing. The serum CA72-4 (Shanghai Yaji Biotechnology Co., Ltd., CL02346)

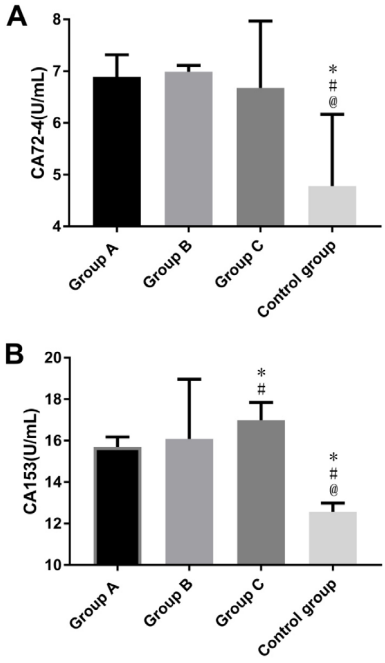

Figure 1. Comparison of serum CA72-4 and CA15.3 levels among the four groups. **A:** Comparison of CA72-4 levels in the serum of the four groups. **B:** Comparison of CA15.3 levels in the serum of the four groups. *indicates comparison with group A (*$p<0.05$). # indicates comparison with group B (#$p<0.05$). @indicates comparison with group C (@$p<0.05$).

and CA15.3 (Beijing Future Biotechnology Co., Ltd., FBLZ0008) were detected by electrochemiluminescence.

Outcome assessments

Main outcome assessments were as follows: the CA72-4 and CA15.3 levels in serum of the four groups; the diagnostic value of CA72-4 and CA15.3 in gynecologic malignancies.

Secondary outcome assessments were as follows: the clinicopathological correlation between CA72-4, CA15.3 and tumors; predictive value of CA72-4 and CA15.3 in the prognosis of patients within 3 years.

Statistics

The results of this study were analyzed by SPSS 24.0 statistical software (Shanghai Yuchuang Network Technology Co., Ltd) and all graphical results were drawn by Graphpad8 (Shenzhen Qiruitian Software Technology Co., Ltd). The counting data were expressed in the form of rates, and chi-square test was used for comparison between groups. The measurement data were expressed in the form of mean±standard deviation, and the comparison between groups was performed with T-test. Comparison between multiple groups was carried out using single factor analysis of variance and least significant difference (LSD) *post hoc* test. The predictive value was analyzed by receiver operating characteristics (ROC) curve, binary logistic regression analysis was used to calculate the joint factor model, followed by ROC curve analysis. The survival rate was calculated by Kaplan-Meier method and compared by Log-rank test. $P<0.05$ was considered as statistically significant difference.

Results

Comparison of CA72-4 and CA15.3 levels

CA72-4 and CA15.3 in the patient serum of groups A, B and C were dramatically higher than those in the control group ($p<0.001$). There was no difference in CA72-4 between groups A, B and C ($p>0.05$), there was no difference in CA15.3 between

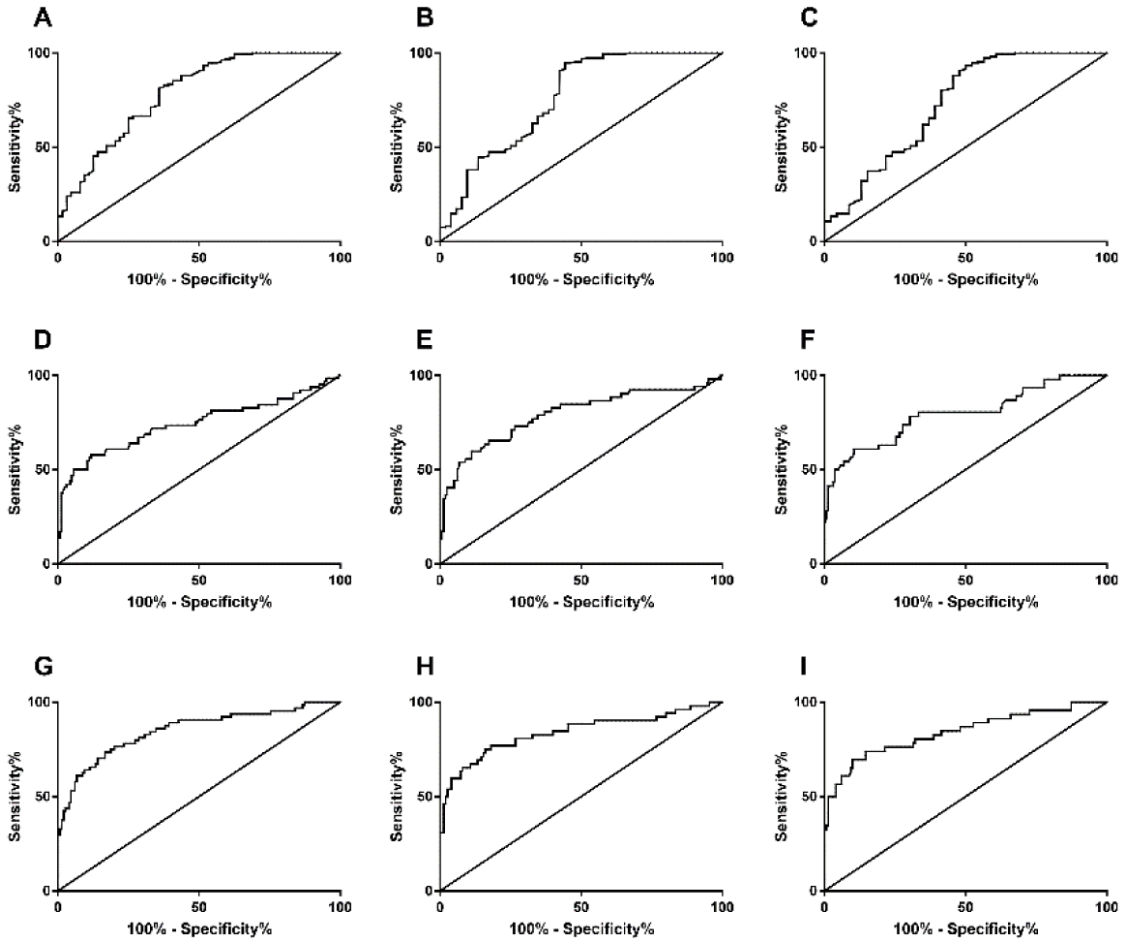

Figure 2. Diagnostic value of CA72-4 and CA15.3 for gynecologic malignancies. **A:** ROC curve analysis of CA72-4 in diagnosing ovarian cancer. **B:** ROC curve analysis of CA72-4 in diagnosing cervical cancer. **C:** ROC curve analysis of CA72-4 in diagnosing endometrial cancer. **D:** ROC curve analysis of CA15.3 in diagnosing ovarian cancer. **E:** ROC curve analysis of CA15.3 in diagnosing cervical cancer. **F:** ROC curve analysis of CA15.3 in diagnosing endometrial cancer. **G:** ROC curve analysis of CA72-4 combined with CA15.3 in diagnosing ovarian cancer. **H:** ROC curve analysis of CA72-4 combined with CA15.3 in diagnosing cervical cancer. **I:** ROC curve analysis of CA72-4 combined with CA15.3 in diagnosing endometrial cancer.

groups A and B (p>0.05), but CA15.3 in group C was higher than that in groups A and B (p<0.05) (Figure 1).

Diagnostic value of CA72-4 and CA15.3 for gynecological tumors

Logistic binary regression analysis was carried out with CA72-4 and CA15.3 as two independent variables, and joint factor prediction model was obtained (Logit (P) =-8.720+0.725× CA72-4+0.265× CA15.3). When the cut-off value was 0.379, the sensitivity and specificity of this model in diagnosing ovarian cancer were 73.44% and 83.33%, respectively. However, when CA72-4 and CA15.3 were combined to detect cervical cancer, Logit (P) was -8.662+0.559×CA72-4+0.311×CA15.3. When the cut-off value was 0.295, the sensitivity and specificity of this model in diagnosing cervical cancer were 75% and 84%, respectively. When CA72-4 and CA15.3 were combined to detect endometrial cancer, Logit (P) was -9.051+0.124×CA72-4+0.077×CA15.3; when the cut-off value was 0.343, the sensitivity and specificity of this model in diagnosing endometrial cancer were 61.42% and 85%, respectively (Figure 2, Tables 1-3).

Clinicopathological correlation between CA72-4, CA15.3 and tumors

CA72-4 was not dramatically tied to pathological type, tissue type, and lesion location of ovarian cancer, tumor morphology of cervical cancer, as well as the pathological type and tissue type of endometrial cancer (p>0.05), but was closely tied to TNM staging and grade of differentiation of ovarian cancer, tissue type, TNM staging, grade of differentiation, and hyperplasia of cervical cancer, as well as TNM staging and grade of differentiation of endometrial cancer (p<0.05). However, CA15.3 was

Table 1. Diagnostic value of CA72-4 for gynecologic malignancies (U/mL)

	Ovarian cancer	*Cervical cancer*	*Endometrial cancer*
Cut-off	6.065	6.905	6.740
Sensitivity (%)	81.33	94.67	93.33
Specificity (%)	64.06	55.77	50.00
AUC	0.784	0.760	0.728
95%CI	0.714-0.855	0.675-0.845	0.633-0.823
Std.Error	0.036	0.043	0.048
P	<0.001	<0.001	<0.001

Table 2. Diagnostic value of CA15.3 for gynecologic malignancies (U/mL)

	Ovarian cancer	*Cervical cancer*	*Endometrial cancer*
Cut-off	15.270	15.310	15.480
Sensitivity (%)	57.81	59.62	60.87
Specificity (%)	88.27	88.89	89.51
AUC	0.742	0.792	0.794
95%CI	0.659-0.825	0.712-0.872	0.712-0.876
Std.Error	0.042	0.041	0.042
P	<0.001	<0.001	<0.001

Table 3. Diagnostic value of CA72-4 combined with CA15.3 for gynecologic malignancies (U/mL)

	Ovarian cancer	*Cervical cancer*	*Endometrial cancer*
Cut-off	0.379	0.295	0.343
Sensitivity (%)	73.44	75.00	61.42
Specificity (%)	83.33	84.00	85.00
AUC	0.849	0.839	0.840
95%CI	0.788-0.910	0.765-0.913	0.765-0.915
Std.Error	0.031	0.038	0.038
P	<0.001	<0.001	<0.001

not dramatically correlated to pathological type, tissue type, and lesion location of ovarian cancer, tissue type and tumor morphology of cervical cancer, as well as pathological type and tissue type of endometrial cancer (p>0.05), but was relevant to TNM staging and grade of differentiation of ovarian cancer, tissue type, TNM staging, grade of differentiation, and hyperplasia of cervical cancer, as well as TNM staging and grade of differentiation of endometrial cancer (p<0.05) (Tables 4-6).

Effect of CA72-4 and CA15.3 on prognosis of patients

Cancer patients were followed up for 3 years. A total of 162 patients were followed up successfully, and the success rate of follow-up was 100.0%. The 3-year mortality of group A was 31.25% (20/64), of

Table 4. Relationship between CA72-4, CA15.3 and pathological characteristics of ovarian cancer (U/mL)

	n	*CA72-4*	*t or F*	*P*	*CA15.3*	*t or F*	*P*
Pathological type			0.007	0.993		0.001	0.999
Primary cancer	39	6.89±2.34			16.52±4.20		
Secondary cancer	17	6.97±2.46			16.47±4.14		
Metastatic cancer	6	6.88±2.35			16.49±3.99		
Tissue type			0.006	0.994		0.004	0.996
Sex cord-stromal tumors	2	6.97±2.61			15.95±4.09		
Epithelial tumors	48	6.96±2.36			16.02±4.36		
Germ cell tumors	12	6.85±2.23			16.10±3.64		
TNM staging			9.853	<0.001		7.603	<0.001
Stages I-II	38	5.06±1.77			12.52±4.52		
Stages III-IV	24	9.52±1.68			20.62±3.27		
Differentiation grade			8.726	<0.001		7.854	<0.001
Moderately and highly differentiated	35	4.68±1.57			12.86±3.34		
Poorly differentiated	27	10.52± 3.54			20.57±4.20		
Lesion location			0.123	0.903		0.344	0.732
Unilateral	42	6.85±2.13			16.44±3.34		
Bilateral	20	6.78±2.04			16.10±4.21		

Table 5. Relationship between CA72-4, CA15.3 and pathological characteristics of cervical cancer (U/mL)

	n	*CA72-4*	*t or F*	*P*	*CA15.3*	*t or F*	*P*
Tissue type			4.356	0.018		1.635	0.205
Squamous carcinoma	32	5.70± 2.10			14.21± 4.15		
Adenocarcinoma	15	5.76± 2.16			14.06± 4.08		
Adeno-squamous carcinoma	5	8.63± 1.84			17.63± 3.56		
Hyperplasia			22.251	<0.001		16.723	<0.001
Grade I	22	4.20± 1.42			12.26± 3.20		
Grade II	18	5.48± 1.82			15.62± 2.85		
Grade III	12	8.42± 2.08			18.62± 3.42		
Tumor morphology			0.007	0.999		0.030	0.993
Cauliflower type	18	6.77± 2.14			16.11± 4.20		
Infiltrative type	16	6.82± 2.23			16.39± 4.07		
Ulcerative type	12	6.73± 2.28			16.10± 3.97		
Nodular type	6	6.87± 2.86			16.56± 4.35		
TNM staging			5.207	<0.001		8.558	<0.001
Stages I-II	36	4.62± 1.52			10.62± 2.86		
Stages III-IV	16	7.62± 2.62			18.62± 3.63		
Differentiation grade			6.213	<0.001		8.623	<0.001
Moderately and highly differentiated	32	4.82± 1.47			11.52± 3.08		
Poorly differentiated	20	7.69± 1.84			18.54± 2.45		

Table 6. Relationship between CA72-4, CA15.3 and pathological characteristics of endometrial cancer (U/mL)

	n	*CA72-4*	*t or F*	*P*	*CA15.3*	*t or F*	*P*
Pathological type			0.029	0.972		0.182	0.834
Diffuse type	18	7.06± 2.50			16.20± 4.20		
Focal type	16	6.87± 2.42			15.38± 4.63		
Polypoid type	12	6.92± 2.16			15.42± 4.42		
Tissue type			0.010	0.999		0.033	0.992
Adenocarcinoma	20	6.78± 2.26			16.52± 4.52		
Adeno-acanthoma	13	6.82± 2.52			16.16± 3.86		
Adenosquamous carcinoma	9	6.86± 2.16			16.16± 4.48		
Clear cell carcinoma	4	6.62± 2.82			15.97± 3.72		
TNM staging			7.621	<0.001		5.648	<0.001
Stages I-II	30	4.62± 1.24			12.62± 2.87		
Stages III-IV	16	8.31± 2.05			18.26± 3.82		
Differentiation grade			5.334	<0.001		7.606	<0.001
Moderately and highly differentiated	28	4.84± 1.82			12.54± 3.51		
Poorly differentiated	18	7.63± 1.58			19.84± 2.56		

Table 7. Predictive value of CA72-4 and CA15.3 for death of patients with gynecological tumors within 3 years (U/mL)

	CA72-4	*CA15.3*
Cut-off	6.820	14.330
Sensitivity (%)	80.00	90.00
Specificity (%)	68.18	50.00
AUC	0.783	0.740
95%CI	0.667-0.899	0.618-0.861
Std.Error	0.059	0.062
P	<0.001	0.002

Table 8. Predictive value of CA72-4 and CA15.3 for death of cervical cancer patients within 3 years (U/mL)

	CA72-4	*CA15.3*
Cut-off	8.110	17.420
Sensitivity (%)	72.73	90.91
Specificity (%)	78.05	75.61
AUC	0.803	0.834
95%CI	0.665-0.940	0.709-0.959
Std.Error	0.070	0.064
P	0.002	<0.001

Table 9. Predictive value of CA72-4 and CA15.3 for death of endometrial cancer patients within 3 years (U/mL)

	CA72-4	*CA15.3*
Cut-off	7.915	18.850
Sensitivity (%)	58.33	66.67
Specificity (%)	76.47	76.47
AUC	0.707	0.770
95%CI	0.539-0.875	0.614-0.925
Std.Error	0.086	0.079
P	0.035	0.005

group B was 26.19% (11/52), and of group C was 26.09% (12/46). After comparing dead patients and surviving patients of the three groups, we found that CA72-4 and CA15.3 of dead patients were higher than those of surviving patients (p<0.001). ROC curve analysis revealed that the sensitivity and specificity of CA72-4 for predicting death of ovarian cancer patients of prognosis within 3 years were 80% and 68.18% respectively; its sensitivity and specificity for cervical cancer patients were 72.73% and 78.05% respectively; its sensitivity and specificity for endometrial cancer patients were 58.33% and 76.47% respectively. However, the sensitivity and specificity of CA15.3 for predicting the death

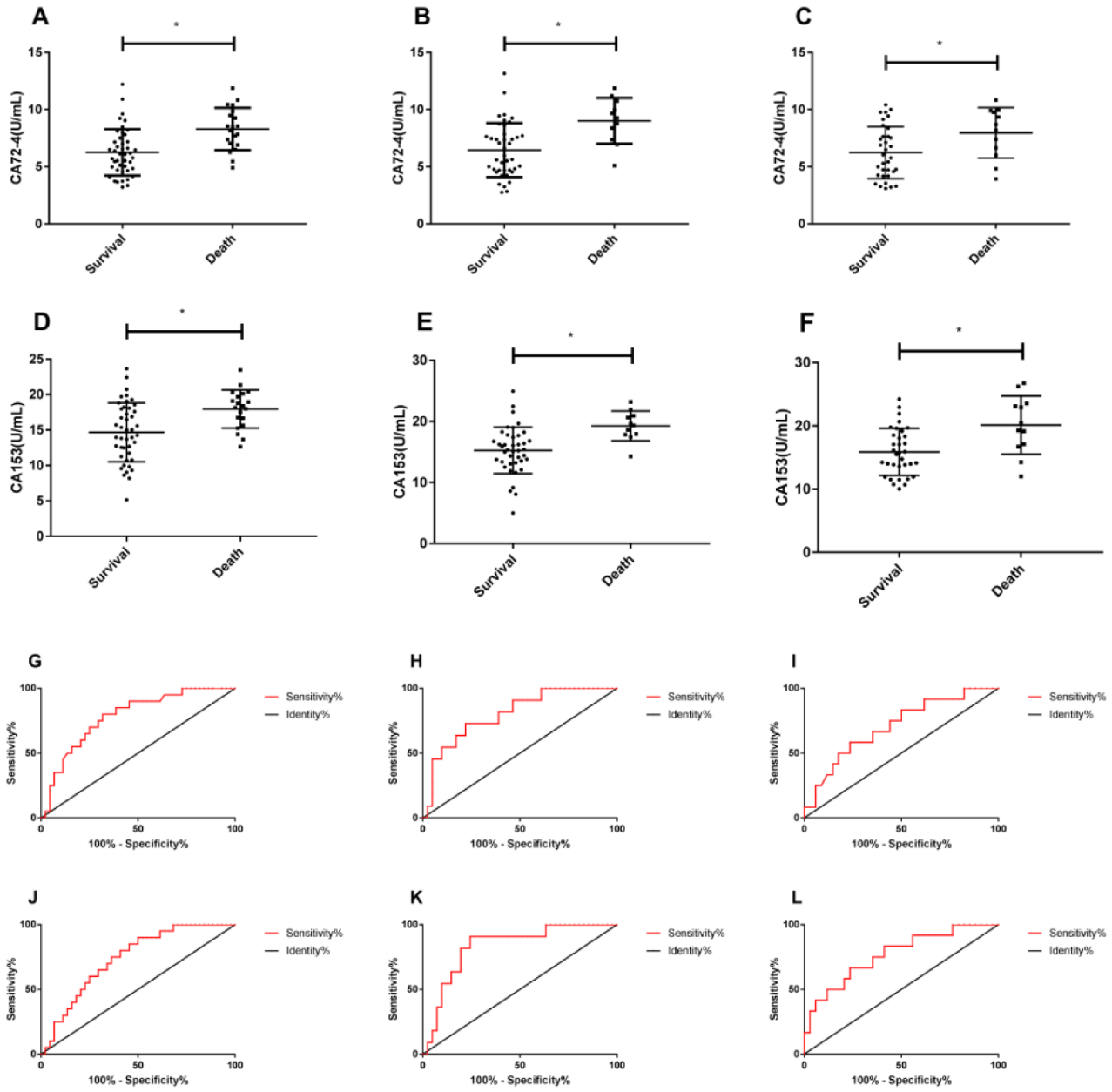

Figure 3. Effect of CA72-4 and CA15.3 on prognosis of patients. **A:** CA72-4 in ovarian cancer survivors compared with dead patients; the latter is higher than the former (*p<0.05). **B:** CA72-4 in cervical cancer survivors compared with dead patients; the latter is higher than the former (*p<0.05). **C:** CA72-4 in endometrial cancer survivors compared with dead patients; the latter is higher than the former (*p<0.05). **D:** CA15.3 in ovarian cancer survivors compared with dead patients; the latter is higher than the former (*p<0.05). **E:** CA15.3 in cervical cancer survivors compared with dead patients; the latter is higher than the former (*p<0.05). **F:** CA15.3 in endometrial cancer survivors compared with dead patients; the latter is higher than the former (*p<0.05). **G:** ROC curve of CA72-4 in predicting the death of ovarian cancer patients within 3 years. **H:** ROC curve of CA72-4 in predicting the death of cervical cancer patients within 3 years. **I:** ROC curve of CA72-4 in predicting the death of endometrial cancer patients within 3 years. **J:** ROC curve of CA15.3 in predicting the death of ovarian cancer patients within 3 years. **K:** ROC curve of CA15.3 in predicting the death of cervical cancer patients within 3 years. **L:** ROC curve of CA15.3 in predicting the death of endometrial cancer patients within 3 years.

of ovarian cancer patients within 3 years were 90% and 50% respectively; its sensitivity and specificity for cervical cancer patients were 90.91% and 75.61% respectively; its sensitivity and specificity for endometrial cancer patients were 66.67% and 76.47%, respectively (Figure 3, Tables 7-9).

Discussion

Early diagnosis is the key to improve the clinical efficacy and prognosis of gynecologic malignancies, which are currently high-risk diseases threatening women's health in clinical practice [18]. Studying tumor markers is of great significance for any tumor. Tumor markers are cytokines that exist in tumor cells or on the surface of cell membranes. They are mainly expressed and secreted by tumor cells into the blood, body fluids or tissues, and are also substances that reflect the body's immune ability to tumor cells [19]. Studying tumor markers is also conducive to the early screening, rehabilitation process and prognosis of tumors. CEA, CA12.5 and CA19.9 are the commonly used clinical serum markers, which are highly sensitive but not specific [20]. In this study, after analyzing the diagnostic value of CA72-4 and CA15.3 for gynecologic malignancies, we found that the CA72-4 and CA15.3 levels in the serum of patients with gynecologic malignancies in the research groups were dramatically higher than in healthy people undergoing physical examination (control group). It was suggested that CA72-4 and CA15.3 were relevant to the occurrence of gynecologic tumors. However, Sun et al [21] and Yu et al [22] reached the same conclusion when studying CA72-4 and CA15.3 in gastric cancer and breast cancer, which could support our results as well. The results revealed that the joint use of the two had good diagnostic value in predicting ovarian cancer, cervical cancer, endometrial cancer and other gynecologic malignancies, which also suggested that CA72-4 and CA15.3 might be excellent diagnostic standards for gynecologic malignancies in the future. CA72-4 is a tumor-associated glycoprotein defined by two monoclonal antibodies, which is used as a judgment standard for digestive tract tumors clinically [23]. However, CA15.3 is a protein attached to the surface of epithelial breast cancer cells, which is highly expressed in these cells and plays a very strong role in promoting the progression, invasion and metastasis of breast cancer [24]. However, after comparing the diagnostic value of CA72-4 and CA15.3 for various gynecologic malignancies, we discovered that the two used alone had no better diagnostic value for tumors. For example, CA72-4 had high sensitivity and low specificity in diagnosing gynecological tumors, while CA15.3 had high specificity and low sensitivity in diagnosing them. Joint detection of the two could make up for each other's shortcomings. It was also suggested that more effective and accurate tumor determination information could be obtained by joint detection of CA72-4 and CA15.3 for tumor markers in future clinical practice. The diagnostic efficacy of joint detection of CA72-4 and CA15.3 in ovarian and cervical cancer was better than in endometrial cancer, which suggested that they might be more suitable for the early screening of ovarian and cervical cancer. Chen et al [25] had the same viewpoint about the diagnostic value of joint detection of multiple tumor markers for gastric cancer. This could further explain that although the tumor markers commonly used in clinical practice were not accurate enough in single detection, they could be effectively improved by combining multiple methods. After analyzing the clinicopathological relationship between CA72-4, CA15.3 and various tumors, we found that CA72-4 and CA15.3 were closely linked in basic gynecologic malignancies (including TNM staging, grade of differentiation, hyperplasia, etc.), which also verified that the two were involved in tumor progression. Clinically, disease progression of ovarian, cervical and endometrial cancer can be judged by detecting CA72-4 and CA15.3, and appropriate treatment measures can be taken to achieve the best efficacy possible. By investigating the 3-year patient survival we also found that CA72-4 and CA15.3 increased in the dead patient group, which confirmed that there was a certain relationship between them and the prognosis of tumor. Through ROC curve analysis, we discovered that CA72-4 had a higher value in predicting the death of ovarian cancer patients within three years, while CA15.3 had a better effect in predicting ovarian and cervical cancer. The cause has not been known yet, so we need further experimental analysis. At present, the most accurate way to judge a tumor is still the pathological detection, which is an invasive and traumatic operation [26]. However, the advantage of using tumor markers is that detection is convenient, and blood drawing can be completed to facilitate clinical popularization and early screening. Moreover, the longer storage time of blood samples is more favorable for retrospective detection and analysis at any time. Nevertheless, the evaluation of results does not need to rely on doctors' previous experience and subjective consciousness, and is more objective and accurate. Therefore, it is of great clinical significance to explore the evaluation level of CA72-4 and CA15.3 for gynecologic malignancies.

However, due to the experimental conditions and the limitations of the current research, we still have some problems that need further experimental verification. For example, since the pathogenesis of tumors is not completely clear at present, we have not conducted *in vitro* experiments to confirm the mechanism of action of CA72-4 and CA15.3 on ovarian, cervical and endometrial cancer. Due to the limited number of cases, other types of gynecologic malignancies couldn't be analyzed, which does not exclude that CA72-4 and CA15.3 may have differential expression in some rare tumors. At present, there are many tumor markers clinically used, and they may be indicators that the joint detection effect is better than CA72-4 and CA15.3. But, the analysis in this study was based on the test results of the laboratory of our hospital, which does not exclude the error between the results obtained by different test reagents and methods. This is the limitation of our research and a key point of future research. We aim to conduct a more in-depth and comprehensive analysis on the application of tumor markers in gynecologic malignancies to obtain the best experimental results.

To sum up, CA72-4 and CA15.3 increase dramatically in ovarian, cervical and endometrial cancer among gynecologic malignancies. Joint detection of the two has a better effect in diagnosing ovarian and cervical cancer.

Conflict of interests

The authors declare no conflict of interests.

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