

This is a selection of clinical papers that highlight the clinical use of DCP in HCC management (January 2009). The summary is directly from the abstract of each paper. Two separate annotated bibliographies for AFP-L3% and three HCC marker combination (AFP, AFP-L3, DCP) assay for HCC management are also available.

Diagnostic usefulness of DCP for hepatocellular carcinoma

- (1) AFP, PIVKA II, GP3, SCCA-I and follistatin as surveillance biomarkers for hepatocellular cancer in non-alcoholic and alcoholic fatty liver disease. Beale G et al., BMC Cancer 2008; Jul 18;8:200.

Summary

The incidence and mortality of hepatocellular cancer (HCC) complicating alcoholic and non-alcoholic fatty liver diseases (ALD and NAFLD) is rising in western societies. Despite knowing the at risk populations for HCC development, the lack of sensitive and specific means of surveillance hampers disease detection at curable stages. The most widely used serum HCC marker is alpha-fetoprotein (AFP), while PIVKA-II, glypican-3 (GP3) and Squamous Cell Carcinoma Antigen -1 (SCCA-1) have been proposed as new biomarkers. Assessment of these HCC biomarkers has largely been performed in patients with viral hepatitis. We conducted a cross sectional study assessing the value of these serum proteins, as well a novel candidate biomarker -follistatin - in patients with HCC arising on a background of ALD or NAFLD. Pre-treatment serum samples from 50 patients with HCC arising on a background of ALD (n = 31) or NAFLD (n = 19) were assessed by specific ELISA assay for PIVKAII, Glypican-3, SCCA-1 and Follistatin. Results were compared and contrasted with a control patient group with biopsy proven steatohepatitis-related cirrhosis (n = 41). The diagnostic accuracy of each of the candidate biomarkers was evaluated using receiver operating characteristic (ROC) curve analysis, reporting the area under the curve (AUC) and its 95% confidence interval (CI). Performance was compared to that of the established biomarker, AFP. Serum levels of all proteins were assessed by specific ELISA assays. GP3, SCCA-1 and follistatin had no HCC surveillance benefit in these patients. AFP and PIVKAII were superior to the other markers, particularly in combination. We conclude that while novel means of surveillance are urgently required, the combination of AFP and PIVKAII for HCC is an improvement on AFP alone in ALD/NAFLD patients. Furthermore, our data in this homogenous subset of patients- particularly that confirming no role for SCCA-1 - suggests that the choice of optimal biomarkers for HCC surveillance may be determined by the aetiology of underlying chronic liver disease.

- (2) Risk factors for hepatocellular carcinoma may impair the performance of biomarkers: A comparison of AFP, DCP, and AFP-L3. Volk M et al., Cancer Biomarkers. 2007; 3:79-87.

Summary

The aim of this case-controlled study was to compare the performance characteristics of the biomarkers AFP, DCP, and AFP-L3% in the diagnosis of HCC, and to determine the effect of risk factors for HCC on test performance. Out of 253 patients 84 were diagnosed with HCC (52 had early stage tumor) and 169 had cirrhosis without HCC. Cutoff values were determined by their ROC analysis: DCP (150 mAU/mL), AFP-L3% (3%), and AFP (23 ng/mL). DCP was the best in differentiating early HCC from cirrhosis, with a sensitivity of 92% and specificity of 93%. In addition, DCP identified 15 (88%) of 17 patients with early stage HCC that would have been missed with total AFP measurement at 20 ng/mL cutoff. The combination of all three markers yielded slightly lower values for sensitivity (88%) and specificity (91%). When the patients were divided into two groups by their risk for HCC, all three markers had a lower sensitivity and area under ROC curve in the high-risk group compared to the low-risk group. The authors conclude, "The combination of markers had excellent performance but the improvement over DCP alone was relatively modest." The authors further suggest that the effect of risk factors for HCC on the performance of biomarkers should be considered and included in the analysis of future studies.

- (3) Des-gamma carboxyprothrombin can differentiate hepatocellular carcinoma from nonmalignant chronic liver disease in American patients. Marrero J et al., Hepatology. 2003; 37(5):1114-1121.

Summary

In this cross-sectional case controlled study it was evaluated whether DCP is more sensitive and specific than AFP for differentiating HCC from nonmalignant liver disease in a cohort of American patients from a single referral center. Four groups were studied: G1, normal healthy subjects; G2, patients with noncirrhotic chronic hepatitis; G3, patients with compensated cirrhosis; and G4, patients with histologically proven HCC. A total of 207 subjects were enrolled. Both DCP and AFP levels increased progressively from G1 to G4, but DCP values had less overlap among the groups than AFP. ROC curve indicated that a DCP value of 125 mAU/mL yielded the best sensitivity (89%; 95% CI, 77%-95%) and specificity (95%; 95% CI, 82%-96%) for differentiating patients with HCC from those with cirrhosis and chronic hepatitis. The optimal AFP cutoff value was 11 ng/mL and was inferior to the DCP value of 125 mAU/mL, the area under the ROC curves being 0.928 versus 0.810, respectively ($p=0.002$). In conclusion, DCP was more sensitive and specific than AFP for differentiating HCC from nonmalignant chronic liver disease. Prospective studies to evaluate the role of DCP in early HCC are underway.

- (4) Usefulness of determining a protein induced by vitamin K absence in detection of hepatocellular carcinoma. Cui R et al., Chin Med J (Engl). 2002; 115(1):42-45.

Summary

Serum des- γ -carboxy prothrombin (DCP) and alpha-fetoprotein (AFP) levels were determined in 60 patients with HCC and 30 patients with cirrhosis not carrying HCC. The mean serum concentration of DCP in HCC patients (784.3 \pm 1364.1 mean \pm s) was higher than that in cirrhosis patients (16.1 \pm 31.7); this difference was highly significant ($p < 0.0001$). When the cutoff level of 40 mAU/ml was used as the level of discriminating HCC from cirrhosis, 51.7% patients (31/60) with HCC had DCP values above this level (sensitivity). Only 4 patients with cirrhosis had such high DCP levels. Thus, the specificity of this test was 86.7% (26/30). Total accuracy was 62.2% [(31+26)/(60+30)]. Seven of 19 small HCCs (36.84%) had DCP values above the cutoff level. Concentrations of AFP above 20 ng/ml were observed in 34 of 60 patients with HCC (56.7%) and in 11 patients with cirrhosis (36.7%). Eleven of 26 patients with HCC (46.2%) without increased AFP had concentrations of DCP greater than 40 mAU/ml. No significant correlation was found between serum levels of AFP and DCP that were measured in 60 HCC patients ($r_s=0.101$, $p = 0.247$). Combining the information from DCP and AFP showed an increase of approximately 21.6% over AFP and 26.7% over DCP alone. For small HCC patients, combining the information from DCP and AFP showed an increase of approximately 15.8% over AFP alone and 21.1% over DCP alone. The authors conclude that DCP is a useful early diagnostic marker for HCC and may be more sensitive when combined with AFP in Chinese patients.

- (5) Use of serum PIVKA-II (DCP) determination for differentiation between benign and malignant liver disease. Lamerz R et al., Anticancer Research. 1999; 19:2489-2494.

Summary

The aim of this study was to investigate the clinical value of DCP in HCC evaluation in comparison with α -fetoprotein. Measurements were performed in duplicate in serum of 87 patients with benign and 154 patients with highly probable (CT, MRT imaging) or histologically proven HCC. Two commercial or research ELISA tests (1: Eitest MonoP-II, Eisai, Tokyo, Japan; 2: Asserachrom PIVKA-II, Stago, France) using murine monoclonal anti-DCP antibodies were used comparatively and compared with a laboratory-developed conventional AFP-RIA. By ROC analysis, a highly significant discrimination ($p < 0.0001$) was found at cutoffs of 0.09 AU/ml (Eisai) or 0.8 ng/ml (Stago) at a specificity of about 90% (Eisai: $s = 78.6\%$, $ppv = 0.92$, $npv = 0.70$; Stago: $s = 77.9\%$, $ppv = 0.93$, $npv = 0.70$) compared with the AFP-test at a cutoff of 45 ng/ml ($s = 91\%$, $s = 58.4\%$, $ppv = 0.92$, $npv = 0.55$). A higher correlation was seen between both DCP tests in malignant ($r_s = 0.89$, $p < 0.0001$) than benign groups ($r_s = 0.41$, $p < 0.001$) and a lower correlation between the AFP and Eisai ($r_s = 0.27/0.36$, $p < 0.001$) and Stago test for the malignant group (0.16; $p < 0.05$). Authors conclude that DCP determination in serum/plasma adds significantly in the discrimination between benign and malignant liver diseases.

- (6) Specific measurement of hypocarboxylated prothrombin in plasma or serum and application to the diagnosis of hepatocellular carcinoma. Grosley BM et al., *J Lab Clin Med.* 1996; 127:553-564.

Summary

This publication describes an evaluation of an enzyme-linked immunosorbent assay (ELISA) for measuring of des- γ -carboxy- prothrombin (DCP) by using a specific monoclonal antibody (P1-2-B9). This assay allowed the measurement of DCP at concentrations ranging from 2 to 200 ng/ml, with an intraassay coefficient of variation of less than 5.3% and an interassay coefficient of variation of less than 7.4%. The concentration of DCP is expressed in nanograms per milliliter. It offers specific measurement without any cross-reactivity from native prothrombin: the specificity for DCP respective to prothrombin is >105. No reactivity was observed with other vitamin K-dependent proteins, whether fully active or decarboxylated. Complementary studies have demonstrated that the monoclonal antibody used was preferentially directed to 3 to 6 Gla hypocarboxylated prothrombin. DCP concentration was below 2.4 ng/ml in normal individuals ($n=59$). In 61 patients given dicoumarol for more than 90 days (receiving a stable therapy), the measured concentrations of DCP ranged from 750 to 13,400 ng/ml. Combined with the assay of α -fetoprotein (AFP), measurement of DCP in patients with liver diseases introduces a complementary exploration for hepatocellular carcinoma (HCC). In a study in 59 patients with HCC, the assay sensitivity was 49.1% for DCP, 47.5% for AFP, and 71% for both markers combined.

- (7) Abnormal prothrombin (Des- γ -carboxy prothrombin) in hepatocellular carcinoma. Nakao A et al., *Hepato Gastroenterol.* 1991; 38:450-453.

Summary

This is one of the early papers that demonstrate the clinical utility of des- γ -carboxy prothrombin (DCP) for detection of hepatocellular carcinoma (HCC). DCP was measured by an enzyme immunoassay (E-1023) using anti-DCP monoclonal antibody in 92 patients with various hepatobiliary diseases. Out of thirty-four patients with non fibrolamellar HCC (non-FL-HCC) and four patients with fibrolamellaer HCC (FL-HCC) thirty-six patients (94.7%) had abnormal DCP levels greater than 0.1 arbitrary unit (AU)/ml. Both alpha fetoprotein (AFP) and DCP were measured at the same time in the 31 patients with non-FL-HCC and in the 4 patients with FL-HCC. Eighteen patients (51.4%) had AFP greater than 100 ng/ml (suspicious levels for HCC) while DCP levels great than 0.1 arbitrary unit (AU)/ml was observed in 33 (94.3%) of the 35 patients with HCC . There was no correlation between plasma or serum DCP and serum AFP levels. Serum AFP was elevated (above 20 ng/ml) in 23 of the 35 patients (65.7%), and DCP was elevated in all of the remaining 12 patients with normal AFP. DCP levels returned to normal levels following curative hepatic resection or orthotopic liver transplantation for HCC. As conclusion DCP is a useful tumor marker in the diagnosis and postoperative monitoring of patients with HCC.

- (8) Sequential fluctuation pattern of serum des- γ -carboxy prothrombin levels detected by high-sensitive electrochemiluminescence system as an early predictive marker for hepatocellular carcinoma in patients with cirrhosis. Shimizu A et al., *International Journal of Molecular Medicine.* 2002; 9:245-250.

Summary

The usefulness of high-sensitive DCP, AFP, and AFP-L3% for the early diagnosis of HCC in 90 patients with viral cirrhosis was studied. Out of 90 patients, 56 patients developed HCC and 34 patients did not develop HCC. Cut off values were: AFP (20 ng/mL), AFP-L3% (10%), DCP (40 mAU/mL). The combination of all three markers gave the highest accuracy overall with 82.1%, 82.4%, 82.2% for sensitivity, specificity, accuracy, respectively. Additionally, Shimizu et al. followed the serial changes of high-sensitive DCP, AFP and AFP-L3% levels in 90 patients over a period of two years. Authors found that the rate of HCC development in patients with fluctuating DCP and AFP-L3% was significantly higher than that in patients who showed non-fluctuating type (93% vs. 56% for DCP and 91% vs. 58% for AFP-L3%). The rate of HCC development was not significantly different for fluctuating and non-fluctuating AFP (69% vs. 59%). Nineteen of 75 patients with non-fluctuating DCP level who had progressively elevated DCP all developed HCC. Importantly, 13 out

of these 19 patients showed the elevation of DCP 3 months before the detection of HCC. Of 79 patients with non-fluctuating AFP-L3%, 15 showed continuously elevated levels until HCC detection. The authors conclude that periodic measurement of the serum DCP levels using high sensitive method is very useful for HCC screening in patients with viral cirrhosis.

Evaluation of therapeutic effect and prognosis after treatment of HCC

- (9) Des-gamma-carboxy prothrombin as an important prognostic indicator in patients with small hepatocellular carcinoma. Hakamada K et al., *World J Gastroenterol.* 2008 Mar 7;14(9):1370-7

Summary

The aim of this study was to clarify the effect of a high des-gamma-carboxy prothrombin (DCP) level on the invasiveness and prognosis of small hepatocellular carcinoma. Among 142 consecutive patients with known DCP levels, who underwent hepatectomy because of hepatocellular carcinoma, 85 patients met the criteria for small hepatocellular carcinoma, i.e. one \leq 5 cm sized single tumor or no more than three \leq 3 cm sized tumors. The overall survival rate of the 142 patients was 92.1% for 1 year, 69.6% for 3 years, and 56.9% for 5 years. Multivariate analysis showed that microscopic vascular invasion ($P=0.03$) and serum DCP \geq 400 mAU/mL ($P=0.02$) were independent prognostic factors. In the group of patients who met the criteria for small hepatocellular carcinoma, DCP \geq 400 mAU/mL was found to be an independent prognostic factor for recurrence-free ($P=0.02$) and overall survival ($P=0.0005$). In patients who did not meet the criteria, the presence of vascular invasion was an independent factor for recurrence-free ($P=0.02$) and overall survivals ($P=0.01$). In 75% of patients with small hepatocellular carcinoma and high DCP levels, recurrence occurred extrahepatically. For small hepatocellular carcinoma, a high preoperative DCP level appears indicative for tumor recurrence. Because many patients with a high preoperative DCP level develop extrahepatic recurrence, it is necessary to screen the whole body.

- (10) Intrahepatic distant recurrence after radiofrequency ablation for a single small hepatocellular carcinoma: risk factors and patterns. Okuwako Y et al., *J Gastroenterol.* 2008;43(1):71-8

Summary

The pathogenesis of frequent intrahepatic recurrence of hepatocellular carcinoma (HCC) after surgical resection or local ablation therapy remains uncertain. Risks and patterns of intrahepatic distant recurrence (IDR) of a single, primary HCC lesion after radiofrequency (RF) ablation were examined. Ninety patients with a single primary HCC lesion of less than 3 cm who had complete RF ablation were enrolled in the study. Risk factors for IDR and the patterns of IDR after RF ablation were analyzed. The median follow-up was 37.4 months. IDR was observed in 44 (48.9%) patients. The cumulative rate of IDR was 10.4%, 52.5%, and 77.0% at 1, 3, and 5 years, respectively. Univariate analysis revealed that a pretreatment serum alpha-fetoprotein (AFP) level of $>$ or $=$ 50 ng/ml ($P = 0.0324$), a des-gamma-carboxy prothrombin (DCP) level of $>$ or $=$ 40 mAu/ml ($P = 0.006$), an ablative margin of $<$ 5 mm of the ablation zone ($P = 0.0306$), and a prothrombin time of $<$ 70% ($P = 0.0188$) were related to IDR. A multivariate stepwise Cox proportional hazards regression model revealed that pretreatment serum AFP and DCP level and the ablative margin were independent risk factors for IDR pretreatment. Serum DCP level $>$ or $=$ 40 mAu/ml ($P = 0.025$), local tumor progression ($P = 0.011$), and ablative margin $<$ 5 mm ($P = 0.024$) were related to multiple IDR. HCC patients with high serum AFP or DCP before RF ablation should be carefully followed up to monitor any IDR. A sufficient ablative margin in RF ablation for HCC is required to prevent IDR.

- (11) Positive status of alpha-fetoprotein and des-gamma-carboxy prothrombin: important prognostic factor for recurrent hepatocellular carcinoma. Kaibori M et al., *World J Surg.* 2004; 28(7):702-707.

Summary

The aim of this study was to evaluate prognostic factors after the recurrence of hepatocellular carcinoma (HCC) in patients who had undergone hepatic resection. Authors used univariate and multivariate

retrospective analyses of 29 clinicopathologic factors in 143 patients with recurrent HCC. Patients were classified into four groups according to the positivity of tumor markers at the time of recurrence. Survival rates and prognostic factors were then compared among the four groups. Multivariate analysis revealed four independent prognostic factors at recurrence: albumin level < 3.5 g/dl ($p = 0.0003$), period until recurrence ≤ 1 year ($p = 0.0004$), positive status of alpha-fetoprotein and des-gamma-carboxy prothrombin (AFP+/DCP+) ($p < 0.0001$), and portal vein invasion ($p < 0.0001$). Among groups with varying status of AFP/DCP, the survival rate in patients with AFP+/DCP+ at recurrence was significantly lower than those in the other three groups (+/+ 15.9% vs. +/- 47.2%, -/+ 44.8%, or -/- 61.1% at 3 years: $p < 0.05$). The AFP+/DCP+ group also had significantly higher rates of the recurrence appearing ≤ 1 year after operation (+/+ 68.3% vs. +/- 45.2%, -/+ 41.9%, or -/- 32.5%: $p = 0.0108$), extrahepatic recurrence (29.3% vs. 6.5%, 9.7%, or 5.0%: $p = 0.0026$), and no treatment at recurrence (29.3% vs. 9.7%, 9.7%, or 5.0%: $p = 0.0115$). These results indicate that the tumor markers AFP and DCP are significant prognostic factors for recurrent HCC, and their monitoring is essential for improving the prognosis after recurrence.

- (12) Des- γ -carboxy prothrombin as a useful predisposing factor for the development of portal venous invasion in patients with hepatocellular carcinoma. Koike Y et al., *Cancer*. 2001; 91:561-569.

Summary

Two hundred twenty-seven patients with hepatocellular carcinoma (HCC) who did not show portal venous invasion (PVI) and who received percutaneous ethanol injection therapy and/or microwave coagulation therapy at the time of their first hospital admission were enrolled between 1994 and 1996. After their HCC was treated, the patients were followed for a mean of 19 months. For the detection of HCC recurrence and/or development of PVI, ultrasonography was performed every 3 months, a computed tomography (CT) scan was performed every 6 months, and the biochemical parameters of the patients were measured every month. Of the 227 patients, 24 (11%) later developed PVI. Tabular analysis was performed on these 24 patients and indicated that tumor size, albumin, total bilirubin, prothrombin time, α -fetoprotein (AFP) level, and des- γ -carboxy prothrombin (DCP) level differed significantly between the time of initial admission and the time of PVI development. A univariate analysis performed on the 227 patients indicated that an increase in the numbers of tumors, the histologic tumor grade (differentiation), the AFP level, and the DCP level at the time of initial diagnosis of HCC had a significant correlation with the later development of PVI; and a stepwise, multivariate Cox regression analysis revealed that the DCP level was the strongest predisposing factor ($p < 0.0010$; risk ratio = 5.65) followed by the histologic grade of tumor differentiation. The results suggest that the serum DCP level is the most useful predisposing clinical parameter for the development of PVI.

- (13) Des- γ -carboxy prothrombin and α -fetoprotein positive status as a new prognostic indicator after hepatic resection for hepatocellular carcinoma. Shimada M et al., *Cancer*. 1996; 78(10):2094-2100.

Summary

The aim of this study was to elucidate the usefulness of measuring the positive status of both des-gamma-carboxy prothrombin (DCP) and alpha-fetoprotein (AFP) preoperatively as a new prognostic indicator of hepatocellular carcinoma (HCC). One hundred forty-seven patients who underwent curative hepatic resection for primary HCC were studied. The definitions of DCP and AFP positivity were: positive DCP > 0.1 AU/ml, and positive AFP > 50 ng/ml. The patients were classified into four groups according to their levels of positivity for DCP and/or AFP: Group 1 ($n = 59$), negative levels of both DCP and AFP; Group 2 ($n = 28$), negative DCP and positive AFP levels; Group 3 ($n = 31$), positive DCP and negative AFP levels; and Group 4 ($n = 29$), positive levels of both DCP and AFP. Patient survival and disease free survival in Group 4 were the worst among the four groups. By multivariate analysis, using Cox proportional hazards model, both the DCP- and AFP-positive status (in combination) and poorly differentiated histology were independent factors of poor prognosis for patient survival; and DCP- and AFP-positive status (in combination), poorly differentiated histology, positive intrahepatic metastasis, and tumor diameter over 5 cm were independent factors of poor prognosis for disease free survival. The combination of DCP- and AFP-positive status is a new prognostic indicator for patients with HCC after hepatic resection.

Comparison of DCP positive HCC characteristics and other findings

- (14) Sensitivity and specificity of des-gamma-carboxy prothrombin for diagnosis of patients with hepatocellular carcinomas varies according to tumor size. Nakamura S et al., Am J Gastroenterol. 2006;101(9):2038-2043.

Summary

The aim of this study was to examine the diagnostic efficacy of DCP and AFP in differentiating HCC from chronic liver diseases. Nakamura et al. examined 1,377 HCC patients and 355 patients with chronic hepatitis or cirrhosis (non-HCC). The median values of DCP and AFP were 60 mAU/mL and 34 ng/mL in HCC patients, respectively, and 18 mAU/mL and 3 ng/mL in non-HCC patients, respectively. The areas under the receiver operating characteristic (ROC) curves of DCP and AFP were 0.812 and 0.887, respectively ($p < 0.0001$). The area under the DCP ROC curve was significantly smaller than that of AFP in tumors less than 3 cm in diameter ($p < 0.0001$). However, the ROC area of DCP was significantly larger than that of AFP in tumors greater than 5 cm in diameter ($p < 0.0001$). The authors concluded that the utility of DCP for the diagnosis of HCC was lower than that of AFP for small tumors, but higher than that of AFP for large tumors.

- (15) Clinicopathological features of patients with hepatocellular carcinoma seropositive for α -fetoprotein-L3 and seronegative for des- γ -carboxy prothrombin in comparison with those seropositive for des- γ -carboxyprothrombin alone. Okuda H, et al., J Gastroenterol Hepatol. 2002; 17(11):772-778.

Summary

The clinicopathologic features of HCC patients with either one or two tumors who underwent a hepatectomy ($n = 88$) were compared among the following five groups according to the seropositivity of AFP, AFP-L3 and DCP: (i) group A, seropositive for AFP above 100 ng/mL, AFP-L3 above 15% and DCP above 100 mAU/mL; (ii) group B, seropositive for AFP-L3 and seronegative for DCP below 40 mAU/mL; (iii) group C, seronegative for AFP below 20 ng/mL, AFP-L3 below 15% and seropositive for DCP; (iv) group D, seropositive for AFP and seronegative for AFP-L3 and DCP; and (v) group E, seronegative for AFP, AFP-L3 and DCP. Group B patients showed a higher incidence of infiltrative-type HCC with an irregular margin ($p < 0.05$) and a higher frequency of poorly differentiated HCC ($p < 0.01$) compared with group C patients. Group A patients had larger tumors and more massive-type tumors than group B patients. The authors' HCC cases showed that advanced clinicopathologic features were demonstrated in the order of group B, group C and group D. Group A and B patients and group D and E patients showed similar characteristics. HCC patients who were seropositive for AFP-L3 and seronegative for DCP demonstrated clinicopathologic features of more advanced HCC compared with those who were seropositive for DCP alone.

Measurement technique of DCP

- (16) Development of des-gamma-carboxy prothrombin (DCP) measuring reagent using the LiBASys clinical analyzer. Yamaguchi I et al., Clin Chem Lab Med. 2008;46(3):411-6

Summary

This paper describes the method of DCP measurement in human serum using liquid binding assay (LBA), which enables rapid antigen-antibody reaction and bound/free separation on the LiBASys clinical analyzer. The dilution curve for DCP was linear up to 500 ng/mL. The limit of detection of DCP concentration was 0.5 ng/mL. Intra- and inter-assay coefficients of variation of DCP were 0.7%-2.4% and 2.2%-6.5%, respectively. This method was free from interference by hemoglobin, bilirubin, ditauobilirubin, intrafat, ascorbate, galactose, glucose and rheumatoid factor. The analytical recoveries of DCP added to serum were 91.7%-108.2%. DCP concentration measured with the LBA method was linear and was significantly correlated with that measured with the ELISA method. The LiBASys clinical analyzer made possible measurement of the complementary tumor markers, HCC, total AFP, AFP-L3 and DCP.