CEA

cobas®

Carcinoembryonic antigen

REF	Σ	SYSTEM
		MODULAR ANALYTICS E170
04491777 190	200	**cobas e** 601
		cobas e 602

English

Please note

The measured CEA value of a patient's sample can vary depending on the testing procedure used. The laboratory finding must therefore always contain a statement on the CEA assay method used. CEA values determined on patient samples by different testing procedures cannot be directly compared with one another and could be the cause of erroneous medical interpretations.

If there is a change in the CEA assay procedure used while monitoring therapy, then the CEA values obtained upon changing over to the new procedure must be confirmed by parallel measurements with both methods.

Intended use

Immunoassay for the in vitro quantitative determination of carcinoembryonic antigen in human serum and plasma. This assay is further indicated for serial measurement of CEA to aid in the management of cancer patients.

The **e**lectro**c**hemi**l**uminescence **i**mmuno**a**ssay "ECLIA" is intended for use on MODULAR ANALYTICS E170, **cobas e** 601 and **cobas e** 602 immunoassay analyzers.

Summary

CEA is a monomeric glycoprotein (molecular weight approximately 180000 daltons) with a variable carbohydrate component of approximately 45-60 %.[1]

CEA, like AFP, belongs to the group of carcinofetal antigens that are produced during the embryonic and fetal period. The CEA gene family consists of about 17 active genes in two subgroups.[2] The first group contains CEA and the **N**on-specific **C**ross-reacting **A**ntigens (NCA); the second group contains the **P**regnancy-**S**pecific **G**lycoproteins (PSG).

CEA is mainly found in the fetal gastrointestinal tract and in fetal serum. It also occurs in slight quantities in intestinal, pancreatic, and hepatic tissue of healthy adults. The formation of CEA is repressed after birth, and accordingly serum CEA values are hardly measurable in healthy adults.

High CEA concentrations are frequently found in cases of colorectal adenocarcinoma.[3] Slight to moderate CEA elevations (rarely > 10 ng/mL) occur in 20-50 % of benign diseases of the intestine, the pancreas, the liver, and the lungs (e.g. liver cirrhosis, chronic hepatitis, pancreatitis, ulcerative colitis, Crohn's Disease, emphysema).[4] Smokers also have elevated CEA values.

The main indication for CEA determinations is the follow-up and therapy-management of colorectal carcinoma.

CEA determinations are not recommended for cancer-screening in the general population. CEA concentrations within the normal range do not exclude the possible presence of a malignant disease.

The antibodies react with CEA and (as with almost all CEA methods) with the meconium antigen (NCA2).[5] Cross-reactivity with NCA1 is 0.7 %.

The reactive epitopes of CEA have been characterized, and the available monoclonal antibodies classified into 6 epitope groups.[6,7] The antibodies used in the Elecsys CEA assay react with epitopes 2 and 5.

Test principle

Sandwich principle. Total duration of assay: 18 minutes.

- 1st incubation: 10 µL of sample, a biotinylated monoclonal CEA-specific antibody, and a monoclonal CEA-specific antibody labeled with a ruthenium complex[a)] react to form a sandwich complex.
- 2nd incubation: After addition of streptavidin-coated microparticles, the complex becomes bound to the solid phase via interaction of biotin and streptavidin.
- The reaction mixture is aspirated into the measuring cell where the microparticles are magnetically captured onto the surface of the electrode. Unbound substances are then removed with ProCell/ProCell M. Application of a voltage to the electrode then induces chemiluminescent emission which is measured by a photomultiplier.
- Results are determined via a calibration curve which is instrument-specifically generated by 2-point calibration and a master curve provided via the reagent barcode.

a) Tris(2,2'-bipyridyl)ruthenium(II)-complex ($Ru(bpy)_3^{2+}$)

Reagents - working solutions

The reagent rackpack is labeled as CEA.

M Streptavidin-coated microparticles (transparent cap), 1 bottle, 12 mL:

Streptavidin-coated microparticles 0.72 mg/mL; preservative.

R1 Anti-CEA-Ab~biotin (gray cap), 1 bottle, 18 mL:

Biotinylated monoclonal anti-CEA antibody (mouse/human) 3.0 mg/L; phosphate buffer 100 mmol/L, pH 6.0; preservative.

R2 Anti-CEA-Ab~$Ru(bpy)_3^{2+}$ (black cap), 1 bottle, 14 mL:

Monoclonal anti-CEA antibody (mouse) labeled with ruthenium complex 4.0 mg/L; phosphate buffer 100 mmol/L, pH 6.5; preservative.

Precautions and warnings

For in vitro diagnostic use.
Exercise the normal precautions required for handling all laboratory reagents.
Disposal of all waste material should be in accordance with local guidelines.
Safety data sheet available for professional user on request.

Avoid foam formation in all reagents and sample types (specimens, calibrators and controls).

Reagent handling

The reagents in the kit have been assembled into a ready-for-use unit that cannot be separated.

All information required for correct operation is read in from the respective reagent barcodes.

Storage and stability

Store at 2-8 °C.

Do not freeze.

Store the Elecsys reagent kit **upright** in order to ensure complete availability of the microparticles during automatic mixing prior to use.

Stability:	
unopened at 2-8 °C	up to the stated expiration date
after opening at 2-8 °C	12 weeks
on the analyzers	4 weeks

Specimen collection and preparation

Only the specimens listed below were tested and found acceptable.

Serum collected using standard sampling tubes or tubes containing separating gel.

Li-heparin, Na-heparin, K_3-EDTA and sodium citrate plasma. When sodium citrate is used, the results obtained must be corrected by + 10 %.

Criterion: Recovery within 90-110 % of serum value or slope 0.9-1.1 + intercept within < ± 2x analytical sensitivity (LDL) + coefficient of correlation > 0.95.

Stable for 7 days at 2-8 °C, 6 months at -20 °C.[8]

The sample types listed were tested with a selection of sample collection tubes that were commercially available at the time of testing, i.e. not all

available tubes of all manufacturers were tested. Sample collection systems from various manufacturers may contain differing materials which could affect the test results in some cases. When processing samples in primary tubes (sample collection systems), follow the instructions of the tube manufacturer.

Centrifuge samples containing precipitates before performing the assay.

Do not use heat-inactivated samples.

Do not use samples and controls stabilized with azide.

Ensure the samples, calibrators and controls are at 20-25 °C prior to measurement.

Materials provided

See "Reagents – working solutions" section for reagents.

Materials required (but not provided)

- REF 11731645322, CEA CalSet, 4 x 1 mL
- REF 11776452122, PreciControl Tumor Marker, for 2 x 3 mL each of PreciControl Tumor Marker 1 and 2 or
  REF 11731416190, PreciControl Universal, for 2 x 3 mL each of PreciControl Universal 1 and 2
- REF 11732277122, Diluent Universal, 2 x 16 mL sample diluent or
  REF 03183971122, Diluent Universal, 2 x 36 mL sample diluent
- General laboratory equipment
- MODULAR ANALYTICS E170 or **cobas e** 601 or **cobas e** 602 analyzer

Accessories for MODULAR ANALYTICS E170, **cobas e** 601 and **cobas e** 602 analyzers:

- REF 04880340190, ProCell M, 2 x 2 L system buffer
- REF 04880293190, CleanCell M, 2 x 2 L measuring cell cleaning solution
- REF 03023141001, PC/CC-Cups, 12 cups to prewarm ProCell M and CleanCell M before use
- REF 03005712190, ProbeWash M, 12 x 70 mL cleaning solution for run finalization and rinsing during reagent change
- REF 12102137001, AssayTip/AssayCup Combimagazine M, 48 magazines x 84 reaction vessels or pipette tips, waste bags
- REF 03023150001, WasteLiner, waste bags
- REF 03027651001, SysClean Adapter M
- REF 11298500316, Elecsys SysClean, 5 x 100 mL system cleaning solution

Assay

For optimum performance of the assay follow the directions given in this document for the analyzer concerned. Refer to the appropriate operator's manual for analyzer-specific assay instructions.

Resuspension of the microparticles takes place automatically prior to use. Read in the test-specific parameters via the reagent barcode. If in exceptional cases the barcode cannot be read, enter the 15-digit sequence of numbers.

Bring the cooled reagents to approx. 20 °C and place on the reagent disk (20 °C) of the analyzer. Avoid foam formation. The system automatically regulates the temperature of the reagents and the opening/closing of the bottles.

Calibration

Traceability: This method has been standardized against the 1st IRP WHO Reference Standard 73/601.

Every Elecsys reagent set has a barcoded label containing specific information for calibration of the particular reagent lot. The predefined master curve is adapted to the analyzer using the relevant CalSet.

Calibration frequency: Calibration must be performed once per reagent lot using fresh reagent (i.e. not more than 24 hours since the reagent kit was registered on the analyzer). Renewed calibration is recommended as follows:

- after 1 month (28 days) when using the same reagent lot
- after 7 days (when using the same reagent kit on the analyzer)
- as required: e.g. quality control findings outside the defined limits

Quality control

For quality control, use PreciControl Tumor Marker or PreciControl Universal.

In addition, other suitable control material can be used.

Controls for the various concentration ranges should be run individually at least once every 24 hours when the test is in use, once per reagent kit, and following each calibration.

The control intervals and limits should be adapted to each laboratory's individual requirements. Values obtained should fall within the defined limits. Each laboratory should establish corrective measures to be taken if values fall outside the defined limits.

Follow the applicable government regulations and local guidelines for quality control.

Calculation

The analyzer automatically calculates the analyte concentration of each sample (either in ng/mL or µg/L).

1 ng/mL CEA corresponds to 16.9 mIU/mL.

Limitations - interference

The assay is unaffected by icterus (bilirubin < 1129 µmol/L or < 66 mg/dL), hemolysis (Hb < 1.4 mmol/L or < 2.2 g/dL), lipemia (Intralipid < 1500 mg/dL) and biotin (< 491 nmol/L or < 120 ng/mL).

Criterion: Recovery within ± 10 % of initial value.

Samples should not be taken from patients receiving therapy with high biotin doses (i.e. > 5 mg/day) until at least 8 hours following the last biotin administration.

No interference was observed from rheumatoid factors up to a concentration of 1500 IU/mL.

There is no high-dose hook effect at CEA concentrations up to 200000 ng/mL.

In vitro tests were performed on 26 commonly used pharmaceuticals. No interference with the assay was found.

In rare cases, interference due to extremely high titers of antibodies to analyte-specific antibodies, streptavidin or ruthenium can occur. These effects are minimized by suitable test design.

For diagnostic purposes, the results should always be assessed in conjunction with the patient's medical history, clinical examination and other findings.

Limits and ranges

Measuring range

0.200-1000 ng/mL (defined by the lower detection limit and the maximum of the master curve). Values below the lower detection limit are reported as < 0.200 ng/mL. Values above the measuring range are reported as > 1000 ng/mL (or up to 50000 ng/mL for 50-fold diluted samples).

Lower limits of measurement

Lower detection limit of the test

Lower detection limit: 0.20 ng/mL

The lower detection limit represents the lowest measurable analyte level that can be distinguished from zero. It is calculated as the value lying two standard deviations above that of the lowest standard (master calibrator, standard 1 + 2 SD, repeatability study, n = 21).

Dilution

Samples with CEA concentrations above the measuring range can be diluted with Diluent Universal. The recommended dilution is 1:50 (either automatically by the analyzers or manually). The concentration of the diluted sample must be > 20 ng/mL.

After manual dilution, multiply the result by the dilution factor.

After dilution by the analyzers, the software automatically takes the dilution into account when calculating the sample concentration.

Expected values

Studies with the Elecsys CEA assay were performed on 352 healthy subjects. The following results were obtained:

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	All subjects		Non-smokers (past/never smokers)		Smokers (current)	
Age (years)	20-69	40-69	20-69	40-69	20-69	40-69
95th percentile (ng/mL)	4.7	5.2	3.8	5.0	5.5	6.5
N	352	203	242	154	110	49

Each laboratory should investigate the transferability of the expected values to its own patient population and if necessary determine its own reference ranges.

Specific performance data

Representative performance data on the analyzers are given below. Results obtained in individual laboratories may differ.

Precision

Precision was determined using Elecsys reagents, pooled human sera and controls in a modified protocol (EP5-A) of the CLSI (Clinical and Laboratory Standards Institute): 6 times daily for 10 days (n = 60); repeatability on MODULAR ANALYTICS E170 analyzer, n = 21. The following results were obtained:

MODULAR ANALYTICS E170, **cobas e** 601 and **cobas e** 602 analyzers						
	Repeatability			**Intermediate precision**		
Sample	Mean ng/mL	SD ng/mL	CV %	Mean ng/mL	SD ng/mL	CV %
Human serum 1	3.32	0.05	1.3	3.90	0.18	4.7
Human serum 2	225	2.53	1.0	252	11.6	4.6
Human serum 3	626	11.8	1.9	699	34.8	5.0
PreciControl TM[b)]1	4.38	0.10	2.5	4.74	0.24	5.1
PreciControl TM2	33.8	0.73	2.0	34.9	1.71	4.9

b) TM = Tumor Marker

Analytical specificity

For the monoclonal antibodies used, the following cross-reactivities were found:

NCA1 < 0.7 %, NCA2 72 %.

No cross-reactivity with AFP and α_1-acid glycoprotein.

No investigations into possible cross-reactivity with glycoproteins from the lungs and liver have been performed.

References

1 Gold P, Freedman SO. Demonstration of tumor-specific antigen in human colonic carcinomata. J Exp Med 1965;121:(3)439.

2 Thompson JA. Molecular cloning and expression of carcinoembryonic antigen gene family members. Tumor Biol 1995;16:10-16.

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4 Sell SS. Serological Cancer Markers. Humana Press 1992; ISBN 0-89603-209-4.

5 Kuroki M, Haruno M, Arakawa F, et al. Reaction profiles of seven enzyme immunoassay kits for carcinoembryonic antigen (CEA) analyzed with purified preparations of CEA and related normal antigens. Clin Biochem 1992;25:29-35.

6 Hammarström S, Shively JE, Paxton RJ, et al. Antigenic sites in carcinoembryonic antigen. Cancer Research 1989;49:4852-4858.

7 Bormer OP, Thrane-Steen K. Epitope group specificity of six immunoassays for carcino-embryonic antigen. Tumor Biol 1991;12:9-15.

8 Guder WG, Narayanan S, Wisser H, et al. List of Analytes; Pre-analytical Variables. Brochure in: Samples: From the Patient to the Laboratory. GIT-Verlag, Darmstadt 1996:10. ISBN 3-928865-22-6.

For further information, please refer to the appropriate operator's manual for the analyzer concerned, the respective application sheets, the product information and the Method Sheets of all necessary components (if available in your country).

A point (period/stop) is always used in this Method Sheet as the decimal separator to mark the border between the integral and the fractional parts of a decimal numeral. Separators for thousands are not used.

Symbols

Roche Diagnostics uses the following symbols and signs in addition to those listed in the ISO 15223-1 standard.

CONTENT	Contents of kit
SYSTEM	Analyzers/Instruments on which reagents can be used
REAGENT	Reagent
CALIBRATOR	Calibrator
→	Volume after reconstitution or mixing

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