



4420

C O L L O I D O S M O M E T E R

W E S C O R , I N C
B I O M E D I C A L P R O D U C T S D I V I S I O N

WESCOR[®]



AUTOMATIC USER PROMPTS

Eliminate manual timing during sample injection and assure accurate reading of the COP plateau.

USER-SELECTABLE UNITS include millimeters of mercury (mmHg), centimeters of water (cmH₂O), or kiloPascals (kPa).

READY-TO-USE MEMBRANES are wet-packed and premounted to make replacement simple and convenient. With proper usage, membranes typically last for hundreds of measurements.

WHOLE BLOOD CAPABILITY provides added convenience when plasma or serum are not readily available. Will also accommodate other biological fluids.



THE SUPERIOR METHOD

Wescor's Colloid Osmometer combines simplicity, reliability and precision in the vital measurement of colloid osmotic pressure (COP) in hospital critical care and surgical centers. Developed with a singular purpose: to provide the physician with a patient's COP status before administering albumin or synthetic colloids and as a precise monitor of this therapy. With many advanced features, Wescor's Colloid Osmometer stands apart as the superior instrument for measuring COP.



FLOW-THROUGH SYSTEM

Wescor's Colloid Osmometer surpasses the competition by virtue of its groundbreaking dual flow-through sample and reference chambers. A small number of lower molecular weight macromolecules are likely to transude any practical membrane. This will compromise the reference solution and give rise to errors in subsequent measurements if not corrected. In the Colloid Osmometer, reference solution can be flushed and exchanged with the same ease and facility as the sample solution. This advantage makes the Wescor Colloid Osmometer the preferred instrument for measuring colloid osmotic (oncotic) pressure.

HOW IT WORKS

The instrument measures the colloid osmotic pressure (COP) of solutions using a membrane--selectively impermeable to protein molecules-- and a sensitive pressure transducer in an osmometer cell designed for optimum clinical performance. The transducer output signal is amplified and converted directly to pressure units displayed in easy to read digital format (LCD). The Wescor Colloid Osmometer is engineered for simplicity in operation and maintenance.

WHAT IS COP?

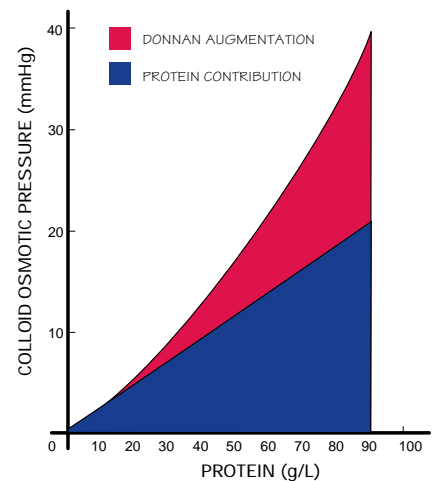
Colloid osmotic pressure (COP, or oncotic pressure) is the equilibrium pressure exerted on a semipermeable membrane separating two solutions of differing osmolality, at least one of which contains membrane-impermeable (colloid) particles.

Human physiology provides a very important example of such a system. The interstitial fluid, which normally contains electrolytes, diffusible non-electrolytes, and relatively small amounts of protein (colloid) is separated from the vascular fluid (blood) by the

semipermeable vascular capillary membrane. The vascular fluid contains considerable amounts of protein solutes in addition to diffusible low molecular weight solutes. In response to differences in the osmolality of these two fluids, water and diffusible solutes will freely transude the vascular membrane until a stable equilibrium is reached.

THE GIBBS-DONNAN EFFECT

At this point, the intravascular fluid will have a slightly higher osmolality than the interstitial fluid (up to 2 mmol/kg difference). This osmolal difference, which accounts for the colloid osmotic pressure, is due to two factors: (a) the presence of the impermeable protein molecules, per se, and (b) an unequal distribution of the diffusible electrolytes between the two compartments at equilibrium. The electrolyte imbalance, known as the Gibbs-Donnan Effect, is brought about by the overall negative electrical charge that the protein molecules possess at blood pH values.



Typically, assuming a normal COP value of 25 mmHg, the osmolality of protein particles contributes approximately 15 mmHg pressure. The electrolyte imbalance caused by these anionic impermeable protein molecules accounts for the remaining 10 mmHg pressure.

PHYSIOLOGICAL SIGNIFICANCE

Serum colloid osmotic pressure is a vitally important factor influencing the quantity of water flux into the vascular compartment across vascular capillary membranes that display normal semipermeable characteristics. Its influence is reduced by the opposing capillary hydrostatic pressure; the net result, in normal circumstances, being a small pressure differential favoring water movement from

the interstitial fluid into the vascular circulation. The physiological significance of this system was first described by Starling in 1896.

CLINICAL APPLICATIONS: PULMONARY EDEMA PREDICTION

The most important specific application of COP measurement at present is the prediction of the onset and degree of edema, particularly pulmonary. From the previous discussion, it will be clear that this information is best provided by a knowledge of both COP and capillary hydrostatic pressure. If the latter exceeds the COP, the normal direction of water movement will be reversed, producing an enlarged extravascular space (hemodynamic pulmonary edema). Such a situation could be corrected by reducing excess hemodynamic pressure and/or increasing COP. Intravenous administration of hyperoncotic albumin solution may be used to augment vascular colloid concentration and thus increase COP.

MONITORING COLLOID THERAPY

The value of using colloid osmometry to detect edema formation and to monitor colloid therapy has been substantiated. Specifically, such monitoring has prognostic significance. Studies have shown that edematous patients with COP values below 12.5 mmHg generally do not survive. On the other hand, patients with values above 20 mmHg have favorable prognoses. Careful judgement should be exercised in the clinical interpretation of COP measurements on serum samples. For example, in some patients the clinical features are complicated by a significant increase in the permeability of the vascular membrane. This allows serum proteins to enter the interstitial compartment to a marked degree. Since laboratory measurement of COP is routinely made with colloid-free isotonic saline solution in the reference chamber, the measured COP in such cases will not truly reflect the 'in vivo' situation. Studies of COP in endotracheal fluid extracted from the lungs give insight as to the presence of vascular membrane lesions and can indicate whether the edema is cardiogenic (hemodynamic) or

non-cardiogenic (permeability) in origin.

It must be appreciated that COP will accurately predict direction and extent of water movement only when a dynamic equilibrium exists (with respect to water and electrolyte movement) between the interstitial and vascular compartments. Gross transient differences in osmolality between these spaces will produce water movements under the influence of forces that temporarily outweigh the relatively subtle effect of vascular colloid. In such circumstances, concomitant serial observations of serum osmolality trends will provide valuable information to draw the attention of medical staff to this possibility.

COP MONITORING DURING PREGNANCY

Recent findings in the field of obstetrics and gynecology have shown that COP measurements can be valuable for monitoring pathologic conditions that arise during pregnancy. These include preeclampsia, pregnancy-induced hypertension,

hypovolemic shock, and tocolytic drug therapy when there is a danger of pulmonary edema.

RELIABLE DIRECT MEASUREMENT

Direct measurement of COP is faster and more reliable than indirect inference of COP from chemical assay of total protein. This is understandable, since the total protein concentration provides no information concerning the specific particle weights or anionic charge of the components of the variable spectrum of serum proteins. Such factors must be quantitatively assessed if theoretical COP is to be calculated with acceptable accuracy. In normal individuals, blood pH and serum protein electrophoretic pattern may be assumed to be normal, leading to a reasonable correlation between calculated and measured COP values. However, in critically ill patients, marked departures from normality invalidate calculated values of COP.

Used in conjunction with serum osmolality measurements, colloid osmometry rapidly provides valuable data

concerning the probability of abnormal changes in the disposition of water among the various body compartments. Additional background is provided by Webster¹ in his comprehensive review of the theory and clinical applications of colloid osmometry.

REFERENCES

1. Webster, H.L., Colloid Osmotic Pressure: Theoretic aspects and background. Clinics in Perinatology 9, 505 (1982).

BUYERS SPECIFICATIONS

The colloid osmometer (oncometer) shall be a Wescor Model 4420 or equivalent and shall operate on the protein-exclusive semipermeable membrane principle. It must be capable of measuring the oncotic pressure of whole blood and other biological fluids by way of a flow-through cell assembly. The reference chamber shall also be flow-through in design and it shall be possible to change reference

solution without removal of the membrane. The membrane shall be packaged in a frame that is self-indexing in the osmometer cell. The pressure transducer shall be mounted internally in the instrument. The colloid osmometer shall have a 64 character alpha numeric display with a power consumption for less than 5 watts.

SUPPLIES AND ACCESSORIES

Wet-packed membranes, torque-indicating hex screwdriver, supplies and accessories necessary for operation of the osmometer are included with the instrument, along with an illustrated instruction manual.

COLLOID OSMOMETER (MODEL 4420) PERFORMANCE SPECIFICATIONS

Sample Volume	350 microliters recommended for routine clinical measurements. Smaller sample volumes down to 125 microliters using special technique.
Sample Loading	Direct syringe injection, flow-through system.
Standard Membranes	Selectively-impermeable to proteins exceeding 30,000 or 10,000 molecular weight. Wet-packed and premounted for easy, self-indexing replacement. (Wescor Cat. No. SS-030 for 30,000 MW; SS-050 for 10,000MW.)
Membrane Life	More than 1000 samples in routine applications provided a wet condition is maintained.
Response Time	3 to 7 minutes, depending upon membrane condition.
Clinical Range	0 to 35mmHg; 0 to 47.6 cm H ₂ O; 0 to 4.67 kPa.
Precision	± 0.3 mmHg with proper membrane function.
Calibration	Osmocoll N (Normal Level) Calibrator.
Readout	64 character alpha-numeric liquid crystal display (LCD).
Electronics	Solid state, microprocessor controlled.
Line Voltage	100V, 115V, or 220/240V (user-selectable), all 50 to 60 Hz.
Power	5 watts.
Fuses	1/8 Amp delay-type for 100V or 115V; 1/16 Amp delay-type for 220/240V.
Size and Weight	19 cm wide x 14 cm high x 28 cm deep, 3.2 kg.
Recorder Output	Scale factor = 10 mV/mmHg. Output Impedance = 500 ohms.

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