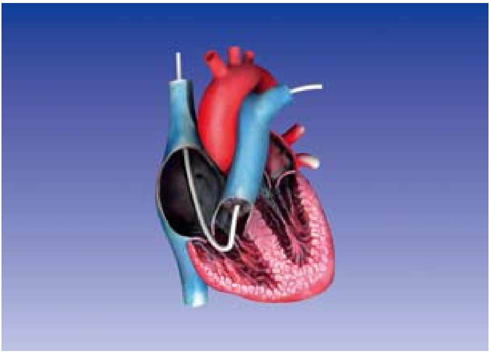
GE Healthcare

Quick Guide



Cardiac Output

What is C.O.?

Cardiac output (C.O.) is the amount of blood ejected by the heart to the peripheral circulation every minute.

Cardiac output equals heart rate (HR) times stroke volume (SV). Stroke volume is the amount of blood pumped by the ventricle by every beat. Normally both ventricles pump the same amount of blood in a minute.

Cardiac output is routinely measured during and after major surgical procedures and with critically ill patients in the ICU.

The primary function of the heart is to deliver sufficient oxygen and nutrients to the tissues. Under normal conditions C.O. varies to comply with total tissue needs. These may change secondary to exercise, infection, heart disease, trauma, surgery or administration of drugs.

Measured C.O. can be normalized to a patient's body surface area (BSA) by dividing C.O. by BSA. The resulting value is called cardiac index (C.I.). Datex-Ohmeda monitors use the Du Bois approximation for BSA calculation.

Why C.O. and Hemodynamic Calculations?

C.O. reflects the status of the entire circulatory system. Together with pulmonary capillary wedge pressure (PCWP) it provides useful information for evaluating left ventricular function.

The right ventricle is a major determinant of left ventricular preload and has an important role in the provision of tissue oxygenation. Right ventricular ejection fraction (REF) is the relative amount of blood ejected from right ventricle each beat.

The parameters that can be derived from HR, blood pressures and C.O. give additional information to assess cardiac function, the effect of drug therapy, and to differentiate the diagnosis.

How is C.O. measured?

The Datex-Ohmeda Monitors utilize the intermittent bolus thermodilution method to determine C.O. Monitoring is achieved with a flow-directed, balloon-tipped catheter which is floated into the pulmonary artery through the right side of the heart. A known amount of injectate at a known temperature is injected through the proximal port (CVP port) of the catheter. After the injection the change in blood temperature is measured near the tip of the catheter in the pulmonary artery. A curve of the temperature change over time is displayed in the C.O. View. This is called a thermodilution curve. C.O. is calculated by using the formula of Stewart-Hamilton.[1)]

Figure 1: C.O. View

Monitors have pre-programmed computation constants for different catheter types. After selection of catheter, the monitor calculates the C.O. using the correct computation constant.

Up to six C.O. measurements can be made and the average of the values is shown automatically.

C.O. can be measured with two modules: E-COP or E-COPSv, which measures also Mixed Venous Oxygen Saturation (SvO_2).

On the monitor digit field you can select numeric value of C.O. or C.I. together with PCWP or REF value.

1) FORMULA : C.O.= K x (TB-Ti)/A
K - computation constant
TB - initial blood temperature
Ti - injectate temperature
A - area under the thermodilution curve

Factors affecting C.O. determination

True changes in C.O. are caused by variations in heart rate and venous return. It is important to check ECG, invasive pressures and temperature while evaluating the C.O..

Many factors may influence C.O. value, e.g. injection technique, time between measurements etc. The injection should be rapid (10 sec.) and smooth. The curve generated should have a steep rise and gradual return to baseline.

Prolonged injections or excess handling of the syringe can reduce the accuracy of the measurement. An inaccurate injectate volume can cause an error of 5-10 %.

Rapid changes in heart rate, blood pressure or pulmonary artery blood temperature may cause irregular curves. Inaccurate values may also result, if the catheter tip is wedged against the vessel wall.

Measurements taken closely together can also cause errors. Thus, it is recommended to wait 5 minutes between measurements with iced injectate and 1 minute between measurements with room temperature injectate.

It is generally recommended to make several C.O. determinations and take the average result. Irregular curves can be discarded in the Edit Average View.

Figure 2: Edit Average View

Hemodynamic Calculations

Cardiac Output together with invasive pressure measurements enables derivating of parameters such as vascular resistance and stroke work.

These values can be reviewed and edited in the hemodynamic calculation view of the monitor. Trends of six sets of hemodynamic calculations can be reviewed and printed.

Figure 3: Hemodynamic calculation view

What information is derived from hemodynamic calculations?

- Systemic vascular resistance (SVR) is the resistance that the left ventricle works against. It is an indicator of left ventricular afterload
- Pulmonary vascular resistance (PVR) is the resistance that the right ventricle works against. It is an indicator of right ventricular afterload
- Left ventricular stroke work (LVSW) is the amount of work that left ventricle does with each beat. It is an indicator of left ventricular contractility
- Right ventricular stroke work (RVSW) is the amount of work that the right ventricle does each beat. It is an indicator of right ventricular contractility
- Right ventricular end diastolic volume (EDV) is the volume of right ventricle, when the heart is filled. It reflects the right ventricular preload
- Right ventricular end systolic volume (ESV) is the volume in the right ventricle when the heart has ejected as much blood as it can. It reflects the right ventricular contractility
- Stroke volume (SV) is the amount of blood ejected with each heart beat. It is an indicator of contractility

Derived parameters

Datex-Ohmeda Monitors calculate the following parameters:

	Formula	Typical values
CI	C.O./BSA	2 - 5 l/min/m^2
SV	C.O./HR * 1000	60 - 90 ml/beat
SI	CI/HR	40 - 60 ml/beat/m^2
LVSW	(ARTmean-PCWP) * SV * 0.0136	gram*metres
LVSWI	(ARTmean-PCWP) * SI * 0.0136	50 - 62 gram * metres/m^2
RVSW	(PAmean-CVP) * SV * 0.0136	gram*metres
RVSWI	(PAmean-CVP) * SI * 0.0136	5 -10 gram * metres/m^2
SVR	(ARTmean-CVP)/C.O. * 80	900 - 1500 dyne * s/cm^5
SVRI	(ARTmean-CVP)/CI * 80	1900 -2400 dyne * s*m^2/cm^5
PVR	(PAmean-PCWP)/C.O. * 80	150 - 250 dyne * s/cm^5
PVRI	(PAmean-PCWP)/CI * 80	225 -315 dyne * s*m^2/cm^5

If REF is measured:

EDV	SV/EF	100 - 160 ml
EDVI	SI/EF	ml/m^2
ESV	EDV-SV	50 - 100 ml
ESVI	EDVI-SI	ml/m^2

GE Healthcare Finland Oy, a General Electric company,
doing business as GE Healthcare.

CAUTION: U.S. Federal law restricts this device to sale by
or on the order of a licensed medical practitioner.

Consult the User's Guide of the monitor for
detailed instructions.

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