PADSY Ergospiro

Ergo-Spirometry + CO

Innocor® – Innovation in cardiovascular diagnostics

- Precise Cardiac Output measurement during stress test
- Ergo-Spirometry + Cardiac Output in a single test
- Unambiguous differential diagnosis of cardiovascular system
- Innocor follows all recommendations of stress test diagnostics

We have sound ideas.

medset
INNOVATION IN CARDIOLOGY

PADSY Ergospiro

Ergo-Spirometry

Innocor® is innovation in Ergo-Spirometry

Innocor® achieves 99 % of the gold standard

Innocor measures oxygen uptake (VO_2) and ventilation (V_E) for cardiopulmonary determination of performance, achieving 99 % accuracy on the basis of the CPX "Douglas Bag" gold standard.

Innocor® saves on costs of consumables

Thanks to Innocor's highly sophisticated gas analyser technology, no more expensive consumables for oxygen measurement (O_2 chemical cells, paramagnetism) and no more daily calibration gases are needed.

Maintenance-free flowmeter

Developed for NASA and optimized for Innocor, the maintenance-free Lilly flowmeter uses a pressure differential measurement at a wafer-thin nylon mesh (minimal breathing resistance) to precisely measure the tidal volume (ventilation) via a pneumotachometer.

Breathing gas analysis by means of spectroscopy

Innocor uses a laser diode to conduct a spectroscopic and thus highly precise measurement of the composition of the breathing gas (VO_2, VCO_2) on a breath-by-breath basis. There is no need for calibration gases for performing daily oxygen/carbon dioxide calibration as is the case with other measurement methods.

Diagnosis graphs already integrated

An integrated formula editor in Innocor makes it easy for you to generate as many individual diagnosis graphs as you like. Standard diagnosis graphs such as the "Wassermann 9-plots" and "calorimetry" are already integrated and can be displayed during measurement.

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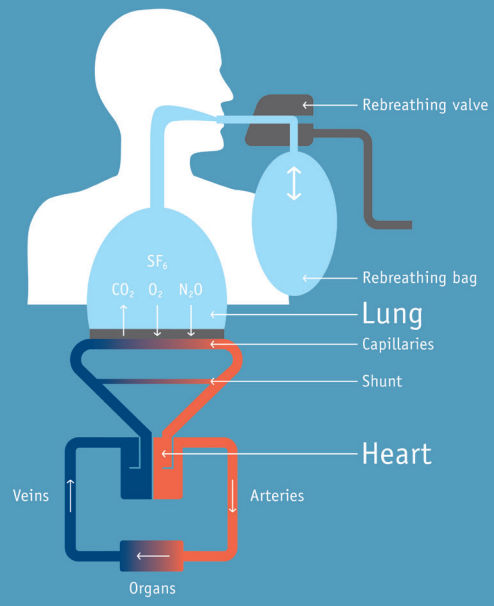
Cardiac Output measurement by Inert Gas Rebreathing (IGR)



Inert Gas Rebreathing (IGR) method

The IGR method is based on the principle that the flow of blood through the lungs (pulmonary blood flow) is proportional to the wash-out rate of a gas that is soluble in blood and that is absorbed during breathing by the pulmonary alveoli.

Pulmonary shunt

If the patient has an intrapulmonary shunt, the percentage shunt flow will be calculated on the basis of the Fick principle for oxygen, stated in % and the pulmonary blood flow to Cardiac Output corrected.

Performing the measurement

The patient first breathes ambient air, the Ergo-Spirometry parameters being measured breath-by-breath, displayed and stored. To measure Cardiac Output, a rebreathing valve switches automatically from ambient air to a rebreathing bag. The bag contains a gas mixture comprising 90 % ambient air enriched with 9.4 % oxygen and the inert gases SF6 (0.1 %, non-soluble in blood) and nitrous oxide (0.5 %, soluble in blood). The two inert gases are continually measured by means of photoacoustic spectroscopy (PAS).

Cardiac Output measurement in Innocor®

Cardiac Output measurement in Innocor uses a redesigned gas analyser that was originally developed for space research to measure the pulmonary gas exchange by means of a mass spectrometer (Amis 2000). For the gas analysis, Innocor uses patented photoacoustic spectrometry (PAS) specially developed for this purpose that conducts particularly precise measurements and offers long-term stability. This makes it very easy to use the IGR method with Innocor in daily routine for the non-invasive measurement of cardiac output at rest and under stress.

Performing the measurement

While rebreathing from the bag, the patient's CO_2 level remains constantly low thanks to the supply of oxygen. After four to five breaths from the bag, the rebreathing valve switches back to ambient air breathing and breath-by-breath measurement of the Ergo-Spirometry parameters resumes. The times at which Cardiac Output measurement is conducted can be incorporated at any time into the stress test protocol or initiated manually (e.g. for peak measurement).

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Ergo-Spirometry + Cardiac Output

Innocor® extends your diagnostic possibilities

Heart, lung or muscle?

By measuring Cardiac Output, a-vDO_2 and VO_2, Innocor® is able after just a few breaths to determine which organ is limiting performance and thus permits a reliable diagnosis for lasting therapy.

For the first time ever, Innocor allows you to measure Cardiac Output directly during an Ergo-Spirometry test with the precision of an invasive measurement. This allows you to determine for the first time how VO_2 and performance are achieved through interaction between Cardiac Output and musculature. Thanks to its unique and simultaneous measurement of the arteriovenous O_2 content and Cardiac Output, Innocor enables a differentiated assessment of the cardiovascular system and thus targeted therapy.

Ideal applications for Innocor®

Chronic heart failure

Innocor allows precise measurement of even tiny changes in the heart, lungs or muscles, providing doctors with clear indications of the necessary therapeutic measures.

Pulmonary hypertension

Innocor offers a risk-free alternative to invasive and expensive measurement methods of monitoring and treating pulmonary hypertension, thereby reducing costs long-term. Measuring systemic vascular resistance and cardiac output under stress makes for reliable monitoring of pulmonary hypertension and more successful therapy.

Optimization of pacemaker systems and resynchronization systems

Precise measurement of Cardiac Power Output allows optimized settings of heart-rate-adapted pacemaker systems under stress and the application of CRT and CCM systems at rest.

Rehabilitation

Innocor allows you to reliably track the success of treatment through the precise measurement of Cardiac Output, peripheral oxygen consumption and maximum oxygen uptake.

Performance diagnosis in (high-level) sport

Innocor is ideally suited to determining performance reserves in high-level athletes. Even under conditions of maximum stress, Innocor continues to conduct precise measurements – the measured parameters permit accurate strategies for targeted performance improvement.

Heart transplant or rehabilitation?

According to the studies *Lang, Mancini et al. Circulation. 2007; 116: II_505 and Circ. Heart Fail 2009; 2; 33–38*, the Cardiac Power Output measured by Innocor is the most important predictor for selecting the correct treatment for a patient (e.g. conventional therapy or heart transplant).

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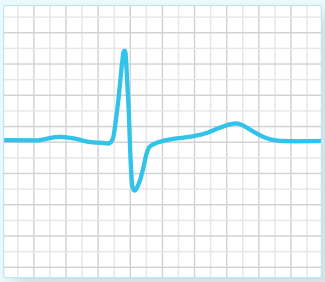
Innocor® offers more diagnostics in ergospirometry

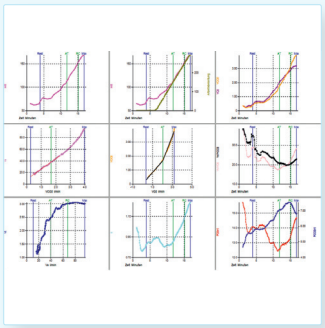


Cardiac functions

- Measurement of peak exercise capacity
- Detection of cardiac arrhythmia and excitation blockades
- Detection of heart muscle perfusion disorders (ischemia)

Ergometry

- Measurement parameters: ECG
- Derived parameters: heart rate (HR), performance [W] or [MET], etc...

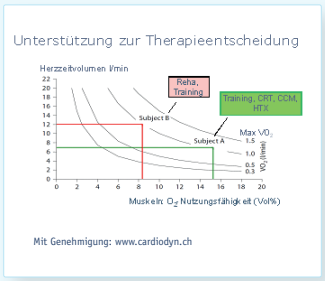


Cardiopulmonary capacity

- Insights into ventilation response (obstruction, restriction) and respiratory efficiency (diffusion, perfusion)
- Quantitative determination of ventilation and metabolic performance (peak VO_2, thresholds, slopes etc.)
- General assessment of patient work (RER)

Ergometry + Spirometry

- Measurement parameters: VO_2, VCO_2, ventilation (VE)
- Derived parameters: VO_2/kg, MET, VT1 and VT2 (aerobic, anaerobic threshold), O_2 pulse, RER, VE (VT, VD), VE/VCO_2 slope, VE/VO_2, VE/VCO_2, respiratory reserve, $petO_2$, $petCO_2$ etc...



Cardiopulmonary performance

- Direct measurement of cardiac pump performance and derived hemodynamic parameters
- Determination of a-vDO_2 (peripheral O_2 consumption in the muscle)
- Determination of oxidative capacity

Ergometry + Spirometry + CO

- Measurement parameters: PBF (Cardiac Output), SpO_2
- Derived parameters: a-vDO_2, cardiac index, Cardiac Power Output (CPO), stroke volume, shunt, systemic vascular resistance, SvO_2 etc....

Textbook Ergo-Spirometry (Kursbuch Spiroergometrie)

and current studies, guidelines and scientific literature (AHA, Handbook of Physiology etc.) recommend, in order to achieve differentiated cardiovascular diagnostics, that Ergo-Spirometry be performed using the IGR method to

- measure Cardiac Output
- determine a-vDO_2

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