

The heart of the matter

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Blood gas analysis at the point of care plays an important role during and after an open-heart surgery. acutearetesting.org recently talked to Prof. Knut Kleesiek, MD, Director of the Institute for Laboratory and Transfusion Medicine of the Heart and Diabetes Center North Rhine-Westphalia in Germany, to find out more about POCT of blood gas in cardiosurgical interventions.

About the Heart and Diabetes Center North Rhine-Westphalia

The Heart and Diabetes Center is a university hospital of the Ruhr-University Bochum. Founded by the federal state of North Rhine-Westphalia in 1984, the center consists of several clinical departments and institutes.

The Heart and Diabetes Center is currently the largest cardiosurgical center in Germany. It is also one of the leading heart centers worldwide, regarding both

its range of surgery and the number of operations performed.

These include standard interventions, such as valve surgery or coronary bypass surgery, but also a large number of operations in children with congenital heart defects. The department of heart surgery transplants more hearts in Germany than any other center, as well as implants worldwide the most ventricular assist devices (VAD) to bridge critical clinical situations.

Blood gas analyses are performed directly at the operating table or intensive care bed. The Heart and Diabetes Center has a total of twelve blood gas analyzers that are located outside the central laboratory: one in each of the six operating theaters, two in the surgical intensive care unit, one in the pediatric intensive care unit and the others on the transplantation and VAD wards.



The Heart and Diabetes Center North Rhine-Westphalia

[acutecaretesting.org: Which analyses are necessary during open-heart surgery?](#)

Prof. Kleesiek: Monitoring laboratory tests during surgery consists primarily of regular blood gas analyses, including the determination of electrolytes, hemoglobin and packed cell volume.

These tasks are performed by the blood gas analyzers. In addition, coagulation tests are required to control anticoagulation during heart-lung machine operations, as well as further tests on demand. These tests are performed on a separate blood sample in the central laboratory, however, and not at the point of care.

[acutecaretesting.org: Which laboratory analyses are performed during and after heart transplantation surgery?](#)

Prof. Kleesiek: The laboratory tests performed during a heart or heart-lung transplantation do not essentially differ from those performed during other types of surgery. Of course, these patients do require intensive laboratory aftercare.

The most important tests for these patients include transplantation immunologic tests, molecular biological tests to recognize virus infections and determination of immunosuppressive drug concentration, which we perform using mass spectrometry.

[acutecaretesting.org: Why are blood gas measurements important for cardiosurgery?](#)

Prof. Kleesiek: Blood gas analysis is a priority during all cardiosurgical interventions since it is the only way of monitoring and controlling sufficient patient oxygenation through the heart-lung machine.

[acutecaretesting.org: Which parameters do you measure?](#)

Prof. Kleesiek: In addition to pH, $p\text{CO}_2$, $p\text{O}_2$, Na^+ and K^+ , we measure glucose and lactate in each sample taken during an operation, as well as oxygen saturation.

[acutecaretesting.org: How do these parameters change during the various phases of a cardiosurgical intervention?](#)

Prof. Kleesiek: Usually the parameters change characteristically during the initial and later phases of surgery.

The critical points for change, when particularly close monitoring is required, are the transition to extracorporeal circulation and the collection of acid metabolic products (lactate) during longer operations and/or in conjunction with complications. Hemoglobin levels can regularly be observed to fall during surgery.

acutecaretesting.org: How often are blood gas analyses performed during a patient's stay?

Prof. Kleesiek: During a complication-free operation lasting – for most patients – two-three hours, five-eight blood gas analyses are performed. This includes the initial phase of the operation.

After surgery, patients are closely monitored in our surgical intensive care unit. There blood gas analyses are performed at half to two-hour intervals, depending on the condition of the patient.

acutecaretesting.org: Do you also measure blood gases while patients are being transported to the center?

Prof. Kleesiek: Blood gas analysis during transport is not necessary since operating theaters and intensive care are nearby. Occasionally patients are transferred to us from other hospitals in intensive care ambulances, which are equipped with blood gas measuring devices.

acutecaretesting.org: How are clinical procedures established, and what is the best way of implementing new methods?

Prof. Kleesiek: The range of tests performed, as well as fundamental organizational procedures, are laid down by the heads of our clinics and institutes. Orientation is provided by the latest scientific standards, as well as the wealth of experience possessed by our center.

Standard procedures are, of course, adapted as required and in accordance with individual patient problems, directions being given by the anesthetist in charge during surgery, and afterwards by the head of our intensive care unit.

acutecaretesting.org: When did your hospital introduce POCT diagnostics?

Prof. Kleesiek: About three years ago we introduced point-of-care blood gas analyses in the operating theaters and intensive care units at our hospital. In our Diabetes Center limited numbers of glucose tests have been performed for some time now.

acutecaretesting.org: Why was point-of-care testing (POCT) introduced in the center?

Prof. Kleesiek: Despite the close proximity of an emergency laboratory, six operating theaters and three intensive care units, our clinical medics wished to see point-of-care blood gas analysis introduced.

Their objective was to render our laboratory more or less independent, providing much faster access to results. It was assumed that the brief time additionally saved could be significant, especially during critical phases of surgery, in conjunction with extracorporeal circulation for children with severe hypothermia or in connection with unforeseen events in intensive care.

acutecaretesting.org: Which challenges did you face when introducing POCT?

Prof. Kleesiek: Training and familiarizing our nurses with the operation of the blood gas analyzers, as well as the reliable conduction of daily quality controls, posed a real challenge. The devices also had to be maintained and calibrated in a satisfactory manner.

acutecaretesting.org: Which measures were taken to guarantee successful operation of the POCT blood gas analyzers?

Prof. Kleesiek: It soon became apparent that giving our nurses exclusive responsibility for the blood gas analyzers was not going to be a viable option. We therefore limited their training to competent patient analyses.

The Institute for Laboratory and Transfusion Medicine is responsible for the POCT devices and analytical results. The daily calibration, maintenance and required quality controls were all placed in the hands of technical staff within our central laboratory.

All POCT users in Germany require a central laboratory; otherwise all participating clinical departments are legally required to participate in ring tests (external quality assurance).

acutecaretesting.org: Was the implementation of POCT of blood gas successful?

Prof. Kleesiek: To a certain extent the introduction of POCT diagnostics was a success. Provided there were no malfunctions or operator errors, the results were available faster during operations.

It should be said, however, that countless problems occurred in conjunction with operating the devices. During surgery there were often no sufficiently trained staff on hand. There were also situations which were particularly stressful, where the ward staff had no time to carry out the numerous analyses. In such cases the central laboratory and its own devices had to be used as a backup.

Overall we are skeptical about using blood gas analyzers without complete or at least partial laboratory supervision.

acutecaretesting.org: Are all blood gas analysis conducted at the point of care?

Prof. Kleesiek: In case of technical or analytical problems, or when clinical departmental staff are under intense pressure, tests are sent to the emergency laboratory.

acutecaretesting.org: What do you do with the analysis results, i.e. data collection and transfer, collation with other patient data, preparation of therapeutic decisions?

Prof. Kleesiek: The parameters generated are collected in the central laboratory using our data management system and then transferred to our laboratory EDP system.

From there the data are available for direct accessing at the operating table or hospital bed via the anesthesia intensive care data management system. All patient data are chiefly available on screen for immediate decision-making, but can also be printed out as required.

acutecaretesting.org: How do you ensure quality of the blood gas measurements conducted at the point of care?

Prof. Kleesiek: The quality control data collected using our BG analyzers are automated by our data management system and made available to the Institute for Laboratory and Transfusion Medicine for observation purposes.

Correct procedures for operating the devices and their quality control are documented in standard instructions for use. The users are trained by staff from the Institute for Laboratory and Transfusion Medicine.

Within the framework of our current quality management system, staff skills and their adherence to instructions will soon be controlled by self-inspection. The central laboratory of our Institute regularly participates in stipulated ring tests (external quality assurance) for all blood gas analysis parameters.

POCT is of great significance for diagnostics in emergency medicine. However, adequate quality control systems often lack. In Germany an important step towards better quality assurance of POCT was taken when the law began to require external quality assurance.

Interviewee

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