Imaging meets Imagination
Hybrid Operating Rooms for Vascular Surgery.
Hybrid Operating Rooms for Vascular Surgery
Vascular surgeons save countless lives every year with procedures such as endovascular repair of aortic aneurysms (EVAR). Because medical personnel increasingly encounter older and obese people who suffer from aortic diseases, you can imagine the growing number of procedures awaiting the field of vascular surgery in the future.

Conventional medical equipment and hospital environments struggle to meet the needs of the patient population. The rise in obesity both contributes to further patient influx and creates technological challenges for imaging systems. And, as the lifespan continues to increase, there will be even more patients with renal insufficiency, restricting the ability to use contrast media during surgery.

Addressing the needs of patients with aortic diseases requires the imagination of a skilled surgeon and the imaging power of the hybrid operating room. Siemens Healthineers offers solutions that feel right at first sight, expanding surgical capabilities and improving clinical outcomes. Our portfolio combines the power of fixed imaging systems with optimized software, enabling excellent image quality at low-dose levels. Perform EVAR procedures hassle-free using the world’s first assisted workflow for stent deployment with fusion imaging. Make routine use of CO₂ as a contrast agent for patients with renal insufficiencies using automatic injection. Whether you want to upgrade a traditional OR or build a larger space for multidisciplinary use, Siemens Healthineers offers solutions independent of constraints. All the while, you benefit from specialized applications that significantly reduce radiation for the patient and the OR team.

Shorter procedures. Less radiation dose and less contrast media consumption. Fewer complications. Let our imaging solutions fuel your imagination.

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Endovascular aortic repair goes hybrid

Hybrid operating rooms maximize clinical capabilities for endovascular repair of aortic aneurysms (EVAR), enabling surgeons to perform complex procedures and simplify standard procedures.

Going hybrid can also reduce costs, helps minimize complications, and improves long-term outcomes in standard EVAR procedures. The switch can also boost a hospital’s reputation for innovation and patient-friendliness.

Reduce operating time and cost

Hybrid ORs boast shorter average operating times than conventional operating rooms with mobile imaging systems. A study by Stanford University\(^1\) reports an operating time reduction of 21% in the Hybrid OR. In addition, hybrid theaters can help cut costs.

Reduce radiation dose and contrast

Patients with aortic aneurysms are often obese, making it difficult to generate high-quality images for precise intraoperative guidance while keeping radiation dose as low as possible. Only fixed angio systems can provide enough X-ray power for efficient beam filtration that significantly reduces radiation exposure for both, the patient and the OR team. When patients present with renal comorbidities, it is necessary to use lower amounts of contrast media. Fusion imaging can help reduce the amount of contrast media required compared to conventional procedures without fusion imaging.\(^2\)

Improve clinical outcomes

On-table 3D imaging following surgery to assess endografts might lead to reduced readmission rates readmissions and can increase long-term clinical outcomes by reducing the risk of future complications. Owing to the fast acquisition time of syngo DynaCT, high-quality 3D imaging takes only 5 seconds, which reduces the amount of contrast media needed.

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\(^1\) Improved Efficiency and Safety for EVAR with Utilization of a Hybrid Room V.N. Varu, J.I. Greenberg, J.T. Lee, Division of Vascular Surgery, Stanford University Medical Center, Stanford, CA, USA

Total OR time (min) 145.6 (+/- 65.8) 115.1 (+/- 48.3) P<.007 n=58 C-arm, 51 Hybrid
Benefit of Hybrid ORs for FEVAR:

- Reduce operation time for complex procedures in the Hybrid OR, enabling optimized workflows
- Reduce radiation dose for you and your team with the optimized imaging capabilities of a fixed imaging system
- Reduce amount of contrast media required with fusion imaging for stent deployment
- Reduce risk of early reinterventions by reviewing procedure results in the OR via intraoperative 3D imaging

Benefit of fusion imaging in Hybrid OR versus conventional X-ray guidance

Results of recent scientific studies demonstrate that the fusion imaging of the 3D dataset to the live x-ray image can significantly decrease the amount of contrast media used in complex endovascular aortic repair.

Combined three-vessel and four-vessel FEVAR:

Mean Contrast (mL)

- Before CT fusion: 100 mL
- With CT fusion: 50 mL (Reduction 57%)

(90 ± 25 vs. 39 ± 17 mL; P < .0001 n=71)

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Contrast usage (90 +/- 25 vs. 39 +/- 17 mL; P < .0001 N=72)

“We recognized very quickly how important hybrid operating rooms are for endovascular treatment of aortic aneurysms – not only because of the radiation protection for the OR team, but because of the accuracy during stent deployment and the reduced use of contrast media as well.”

Dr. Giuseppe Panuccio, Senior Physician
Center for Vascular and Endovascular Surgery, Münster University Hospital, Germany
“It is absolutely striking to see fusion imaging in action, because it allows you to constantly visualize all the critical landmarks on the live monitor during deployment.”

PhD Dr. med. Philipp Geisbüsch, Senior Physician
Clinic for Vascular and Endovascular Surgery, Heidelberg University Hospital, Germany
Repairing aortic aneurysms involves extreme precision and requires the unwavering concentration of the vascular surgeon. Not only are the procedures very complex, but the surgeon has to spend hours planning and preparing – sacrificing time that could be spent attending to the crucial surgical work.

Siemens Healthineers provides solutions that feel right at first sight, expanding surgical capabilities and improving clinical outcomes. With EVAR Guidance Engine, we are offering the first assisted workflow for stent deployment with fusion imaging. With assisted support before, during, and after stent deployment, the endovascular aortic repair workflow reaches unprecedented levels of simplicity and comfort.

**Before the procedure**
EVAR Guidance Engine reduces the time and effort needed for planning EVAR procedures. syngo EVAR Guidance supports the user to prepare and register the CT dataset for fusion imaging. This takes the hassle out of all standard EVAR procedures and helps tackle complex FEVAR cases.

**During the procedure**
EVAR Guidance Engine enables excellent intraoperational visibility of landmarks and devices while greatly reducing radiation dose and contrast. 3D guidance with fusion imaging is available throughout the procedure. The software overlays the contours of the vessels and other anatomical landmarks like renal ostia onto the live image. EVAR xCare protocols keep the radiation dose low the whole time.

3D assessment with syngo DynaCT of stent placement can be used right on the OR table. The result: reduced complications, fewer readmissions, and improved long-term clinical outcomes.

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**At a glance:**
- Assisted preparation of CT dataset with detection of landmarks to reduce preparation time
- 3D guidance with fusion imaging for stent deployment to the use of contrast media
- Optimized low-dose imaging to reduce radiation exposure
- Intraoperative 3D assessment of stent position to reduce complications and early reinterventions

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**Save your brainpower for stent deployment**

EVAR Guidance Engine: The first assisted workflow for endovascular repair

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**Watch the expert interview:**
Prof. Dr. med. Philipp Geisbüsch talks about the EVAR Guidance Engine in the Hybrid OR.

[siemens.com/you-tube/evar-procedure-in-the-hybrid-or](siemens.com/you-tube/evar-procedure-in-the-hybrid-or)
Preparation of CT data for fusion imaging

syngo EVAR Guidance supports the user to prepare the CT dataset for fusion imaging. Based on the mesh modeling of the aortic wall, centerlines are calculated. For all main branch vessels, the ostia rings are visualized and the landing zones for the stent are proposed.

Your benefits:
- Fast preparation for fusion imaging
- Calculation of centerlines allows precise sizing of stent length
- Significant time savings compared to manual preparation

Preparation in typically less than 1 minute

Save up to 15 minutes compared to average manual preparation time
Registration for fusion imaging

Registration of the pre-operational 3D dataset to the angio system requires only two fluoro projections. The alignment of the fluoro scenes to the CT volume is supported by assisted registration of anatomical landmarks like the spine or contrast-filled aorta.

Your benefits:

- Tableside control instead of registration in control room
- Fast assisted alignment of CT data with angio system speeds up registration
- Save radiation dose compared to 3D registration

Assisted 2D registration in 5 minutes
Save up to 10 minutes compared to 3D registration
Assisted workflow steps

Deployment

3D guidance during stent deployment

Fusion imaging provides you with continuous guidance throughout the procedure. The optimal viewing angle for each vessel has already been calculated during preparation. After selecting the target vessel on the heads-up display, the C-arm moves automatically to the calculated optimal angulations.

Your benefits:
- Comfortable selection of branch vessels from heads-up menu
- Fast and radiation-free movement of C-arm to optimal viewing angle

Fast selection of optimal viewing angles with stored C-arm angulations
Save up to 10 minutes compared to manual rotation of 3D volume and manual positioning of C-arm
Immediate assessment of stent position

Assess results right away using intra-operative 3D imaging in excellent quality with syngo DynaCT. Image acquisition in lateral or head side position requires only five seconds.

**Your benefits:**
- Standardized workflow protocols help achieve excellent image quality
- Fast acquisition time reduces contrast agent and radiation dose
- Intraoperative 3D imaging helps reduce complications and early reinterventions
“The new technology enables image quality similar to conventional iodine contrast images – you can hardly see the difference.”

Ulf Teichgräber, Director of Radiology Department
Jena University Hospital, Germany
An improved CO₂ imaging experience
The incidence of acute or chronic kidney impairments among patients with peripheral vascular disease has been rising in recent years. Some patients are also allergic to iodine contrast media used for visualizing vessels. To reduce complications, CO₂ gas can be used as contrast media. CO₂ imaging used to necessitate manual injection, which often results in pain for the patient during injection as well as bad image quality. Siemens Healthineers has developed a solution that greatly improves the CO₂ imaging experience. Artis systems are working in concert with the specialized CO₂ imaging program and an automatic injector, significantly increasing patient comfort as well as image quality.

With ARTIS pheno, the patient can be positioned in Trendelenburg tilting with the head down, which allows CO₂ to flow easily into peripheral vessels. The automated CO₂ injector enables continuous CO₂ inflow with less bubbled gas, improving the image quality and reducing discomfort for the patient.

Image acquisition only requires moving the C-arm of ARTIS pheno along the tilted table, without needing to move the patient. During acquisition, the Evenflow CO₂ imaging programs optimize image contrast and significantly reduce artefacts caused by gas bubbles.

Functional imaging for assessing outcomes right away
Immediately assessing the outcomes of endovascular procedures may help reduce readmissions and improve patient outcomes. With syngo iFlow, enhanced image contrast for blood flow quantification is now available in the OR. syngo iFlow is a software application that uses color coding to show the temporal evolution of contrast at a fixed point within a vessel. This allows a more quantitative flow assessment of lower extremity endovascular interventions and provides a greater understanding of the contrast flow within the pathology, greater ease in visualizing the success of a procedure, and assists the clinician in image review.

Peripheral artery disease imaging
Siemens Healthineers solutions empower the routine use of CO₂ imaging in hybrid environments. Functional imaging with enhanced image contrast allows for simple and effective assessment of results.

At a glance:
- Comfortable, high-quality CO₂ imaging for patients with kidney impairments and iodine allergies
- No need to move the patient during image acquisition
- Immediate assessment of patient outcomes to reduce readmissions and improve patient outcomes with functional imaging reinterventions
A different way of seeing

Vascular Imaging

ARTIS pheno delivers a better CO₂ imaging experience all around: greater comfort, higher image quality – and no need to move the patient.

Your benefits:
• Routine imaging solution for patients with kidney impairments and iodine allergies
• Automated injector delivers greater patient comfort and better image quality
• Image acquisition only requires moving C-arm along tilted table
• Optimized image contrast and fewer artefacts caused by gas bubbles

Peripheral digital angiography
CO₂ contrast imaging
Acquired with CO₂ imaging program
Functional Imaging

Functional imaging lets you assess the outcomes of endovascular procedures right away – reducing readmissions and improving patient outcomes.

Your benefits:
- Immediate outcome assessment reduces readmissions and improves patient outcomes
- Easy visualization of procedure success via enhanced image contrast

Functional imaging of foot following intervention
Acquired with Artis zee and syngo iFlow processing

Functional imaging of foot prior to intervention
Acquired with syngo iFlow processing
Reducing radiation exposure

Reducing radiation dose as much as possible during procedures in the Hybrid OR is important for both, patients and clinical staff. Siemens Healthineers has created applications that enable superior medical care at the lowest reasonable dose.

Siemens Healthineers offers solutions for the Hybrid OR that reduce dose without compromising image quality and clinical outcomes. Dedicated applications help protect the safety of medical staff and make it easy for staff to change their behavior to avoid radiation exposure as much as possible.

**RaySafe: Real-time radiation control**
RaySafe is a dose monitoring system that provides real-time information about personal dose exposure to medical staff. Using dosimeters worn by each member of the medical team, the system provides real-time exposure information. It reminds everyone of radiation exposure and encourages safe behavior for all team members.

**Protective gear**
Protective clothing such as lead aprons, thyroid collars, and glasses – in combination with ceiling-suspended screens and table-mounted lead curtain on both sides of the OR table – protect the OR team against the remaining scattered radiation.

**Facilitating behavior change**
Additional exposure reduction can be achieved through behavior change. Safety mechanisms such as RaySafe facilitate adoption of safe behaviors by providing real-time information. Whenever feasible, the team should increase their distance from the radiation source: the operator should decrease the time for fluoroscopy and stand on the side of the detector where radiation is typically lower.

**Dose-saving protocols**
Siemens Healthineers offers a number of dose-saving protocols that reduce radiation exposure for patients during procedures in the Hybrid OR.

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**Discover CARE+CLEAR**
Find out how CARE+CLEAR improves image quality and optimizes dose in every Artis system.

CAREposition
Allows patient positioning without additional fluoroscopy while moving the table or C-arm based on the last image hold (LIH). A graphical outline of the upcoming image is displayed on the monitor, so that the table or C-arm can be moved without radiation emission. CAREposition helps reduce dose – making it an ideal choice for long procedures in vascular surgery.

CAREfilter
Minimizes patient entrance dose with nearly no impact on image quality. During digital acquisition or fluoroscopy, the variable filtration is set automatically according to the patient’s weight and the angulation of the C-arm. Adjusting the filter size with CAREfilter can result in entrance dose reductions of up to 50%. The new flat emitter tube technology provides sufficient power to use high filtration even on obese patients (250 mA fluoro current, max. 0.9 mm additional CU filter).

CAREvision
Dose reduction by adapting the pulses per second to the lowest possible value. Variable fluoroscopic pulse rates range from 30 p/s to just 0.5 p/s, which considerably reduces radiation exposure. When using 7.5 p/s instead of 30 p/s, for example, dose savings of up to 75% are possible – without losing image quality.

EVAR xCare
EVAR xCare imaging protocols were specifically developed for dose-optimized imaging during EVAR procedures. Ultra low-dose protocols can be chosen right at the table for fluoroscopy and digital subtraction angiography.

At a glance:
- CARE: an integrated package of clinical applications to reduce radiation
- RaySafe allows dose monitoring in real-time and facilitates behavior change
- EVAR xCare protocols allow imaging during EVAR with the lowest possible dose

1 Product dose claims for Artis Q/Q.zen
2 Patient entrance dose = Air kerma; Patient entrance dose rate = Air kerma rate
Built to your needs

Reduce the effort to upgrade your conventional OR to an endovascular Hybrid OR by installing an Artis floor imaging system – or: maximize utilization of the hybrid environment by combining the OR table of your choice with the cutting-edge robotic imaging capabilities of ARTIS pheno.

**Artis floor systems:**

**Upgrades for existing ORs**
The conventional OR may seem too small for a hybrid upgrade due to space limitations. However, most existing ORs larger than 38 m² support installation of an Artis floor system. The integrated Siemens Healthineers OR tables with free-floating tabletops support all vascular and cardiothoracic surgery procedures.

The position flexibility allows imaging from the head, left, or right side. 3D guidance is supported in both the head and lateral imaging position, that allows free access to the patient's head for the anesthesiologist. The system also supports fast intraoperative 3D imaging for assessment in head side position.

**Recommended room size:**

[min 38 m²]

**Discover Go HYBRID!**
Find out how leading medical professionals establish and run their hybrid suites.

*siemens.com/gohybrid*
ARTIS pheno: The perfect choice for multidisciplinary use
A hybrid operating room is the perfect working environment for endovascular procedures, but can also be used for other surgical disciplines, like spine surgery and neurosurgery, orthopedic and trauma surgery, and for laparoscopic surgical procedures. In emergency situations, Hybrid ORs equipped with ARTIS pheno with integrated OR table allow rapid conversion to open procedures for addressing complications. The C-arm can be parked away from the OR table in just a few seconds to give the surgeons free access to the patient.

With ARTIS pheno, 2D and 3D imaging is possible during neurosurgical procedures even in the beach chair position. The flexible C-arm positioning allows imaging at a comfortable working height. Spine surgery has the highest hygienic requirements. To reduce the risk of infections, ARTIS pheno employs intraoperative image guidance with sterile air flow, which meets hygienic requirements even when the C-arm is in the imaging position. For video-assisted thoracic surgery, ARTIS pheno can be used for intraoperational tumor marking and avoids patient transportation.

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System positions with ARTIS pheno

OR table: Siemens multi-tilt table, Trumpf 7500 or Maquet Magnus.

Free laminar flow ceiling

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<th>Thoracic surgery</th>
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