

GE Healthcare

## Complex EVAR procedure

performed with Discovery IGS 730

by

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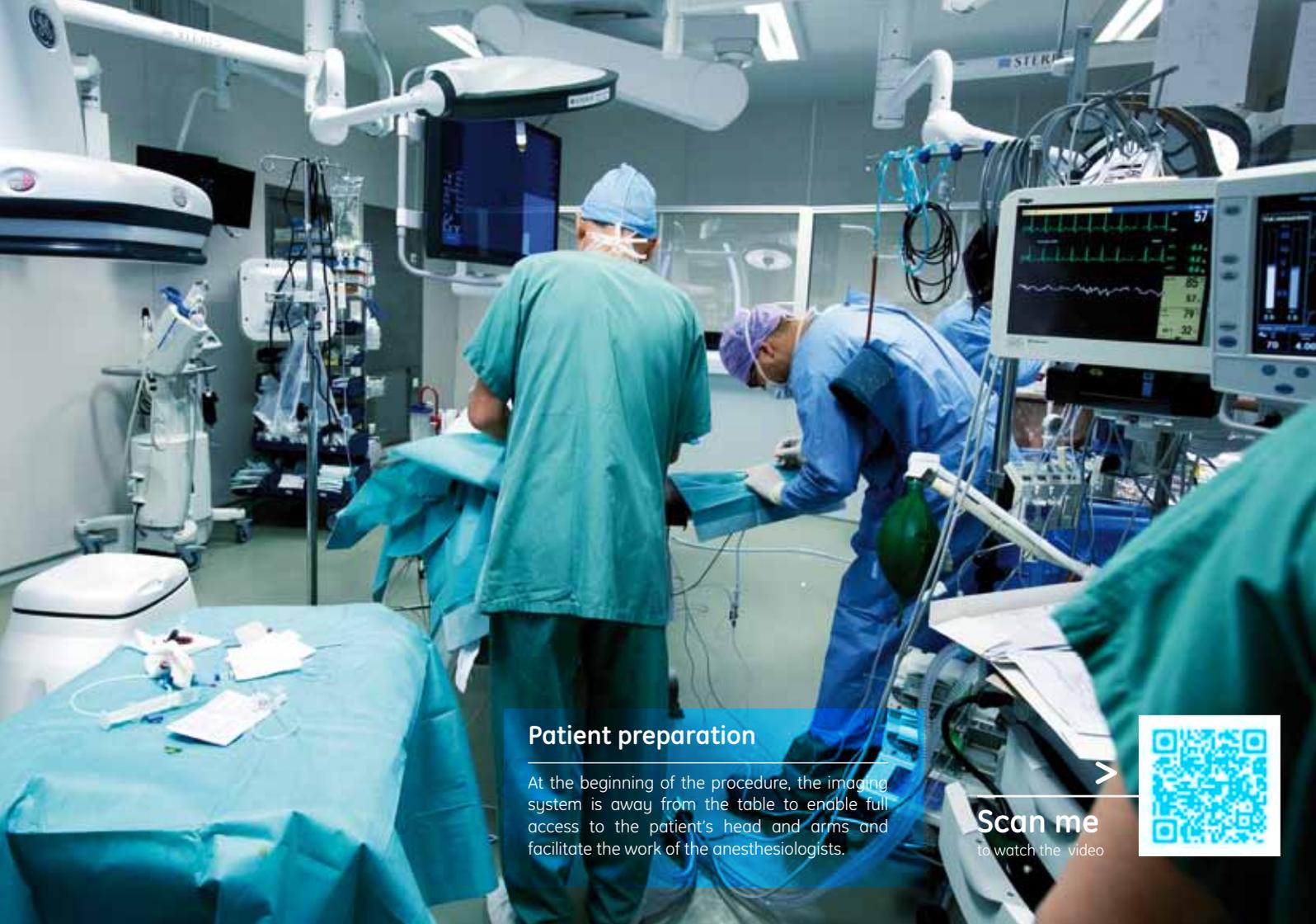
GE imagination at work

## Introduction

Pr. Stephan Haulon is head of the Vascular Surgery Department of Lille University Hospital, which performs about 250 endovascular aortic repair (EVAR) procedures a year, including treatment of infra-renal, para-renal and thoraco-abdominal aneurysms.

The typical workflow used by Pr. Haulon during complex EVAR procedures is illustrated here on a FEVAR procedure with four branches. The patient was treated in the Discovery\* IGS 730 hybrid OR, equipped with the (T)EVAR Assist solution. (T)EVAR Assist is an integrated solution to help plan, guide and follow-up (T)EVAR cases and includes VessellIQ\* Xpress, VVI, Synchro3D and Innova\* Vision.





## Patient preparation

At the beginning of the procedure, the imaging system is away from the table to enable full access to the patient's head and arms and facilitate the work of the anesthesiologists.



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SIAPLR

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Pre-Stent Aorta Analysis  
Post-Stent Aorta Analysis  
Renal Analysis  
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Show Innova Protocols List

Pre-Stent Aorta Analysis

Click here to open the panel

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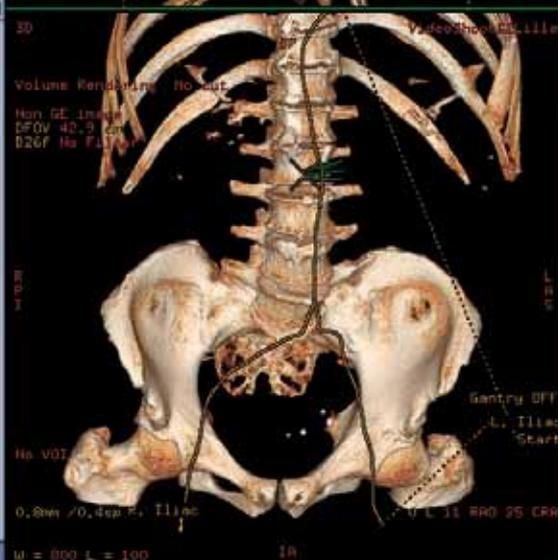
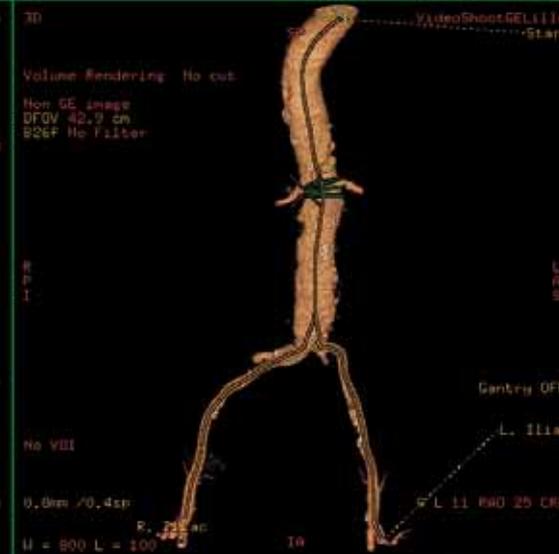
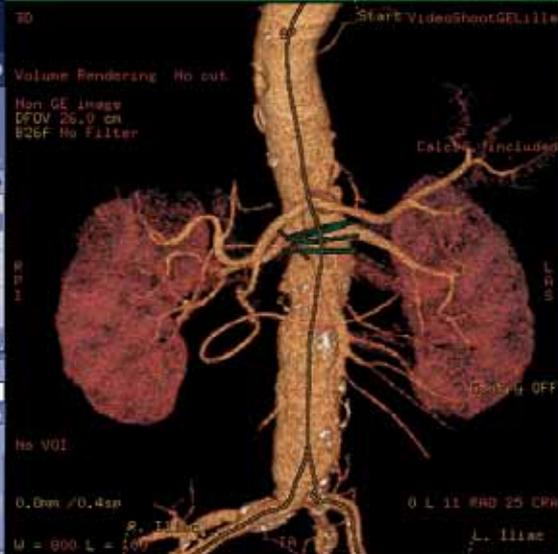
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## Preparation of the 3D CT images

CT images are visualized and prepared for 3D overlay in the control room on the Advantage Workstation, the post-processing workstation integrated to Discovery IGS 730. This requires only few minutes to plan from the CTA using 0-click bone removal and vessel tracking. The 3D bone and vascular models are then available and are exported in a single click to Innova Vision, which overlays them on top of the fluoroscopy images.



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## Cutdown

The imaging system is away from the table, enabling full access to the patient's sides to facilitate the work of the surgeons performing the cutdown.



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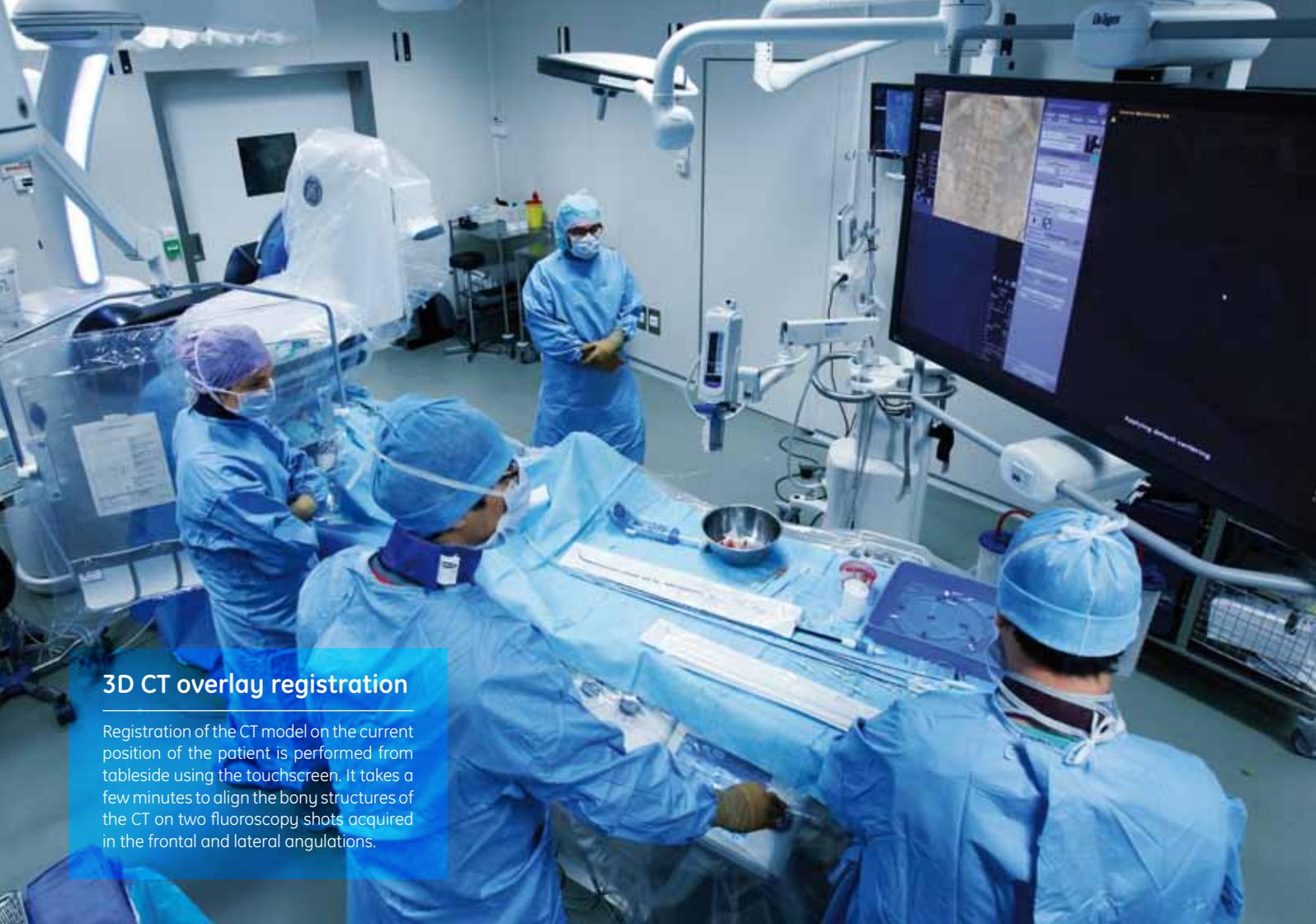
## Gantry motion to imaging position

When ready to start imaging, the Discovery IGS 730 is moved to the table using the One-Touch Back-In functionality available from tableside.



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### 3D CT overlay registration

Registration of the CT model on the current position of the patient is performed from tableside using the touchscreen. It takes a few minutes to align the bony structures of the CT on two fluoroscopy shots acquired in the frontal and lateral angulations.



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## Follow the table

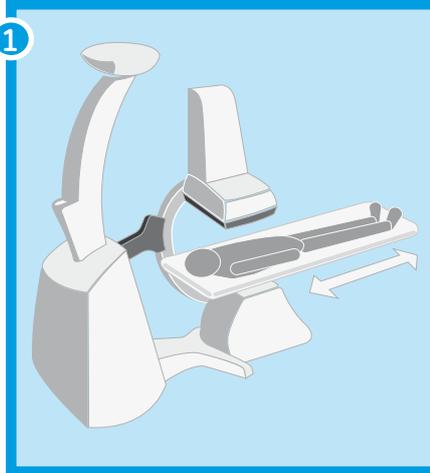
As the tabletop is panned to image the visceral or iliac arteries, the 3D model automatically follows, allowing centering of the anatomy of interest without need to shoot X-ray.



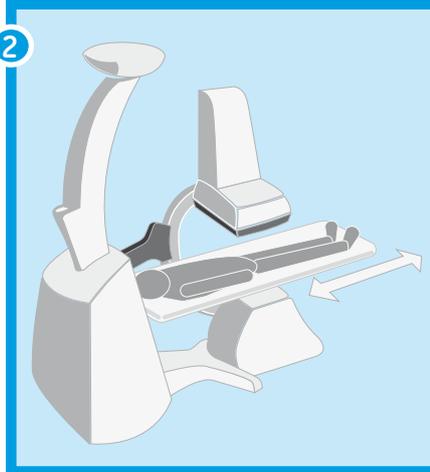
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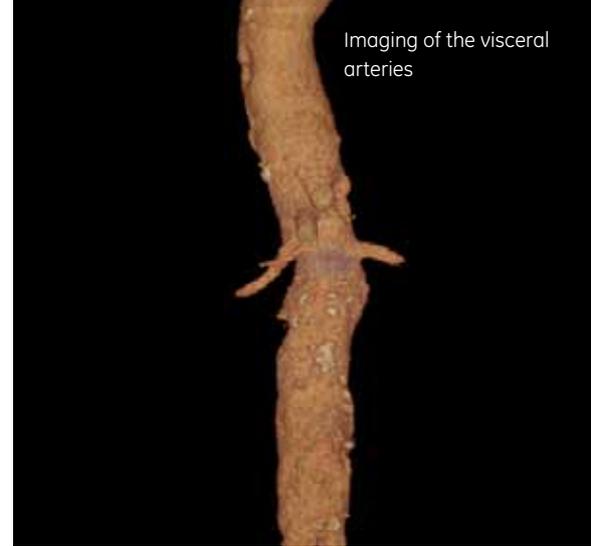
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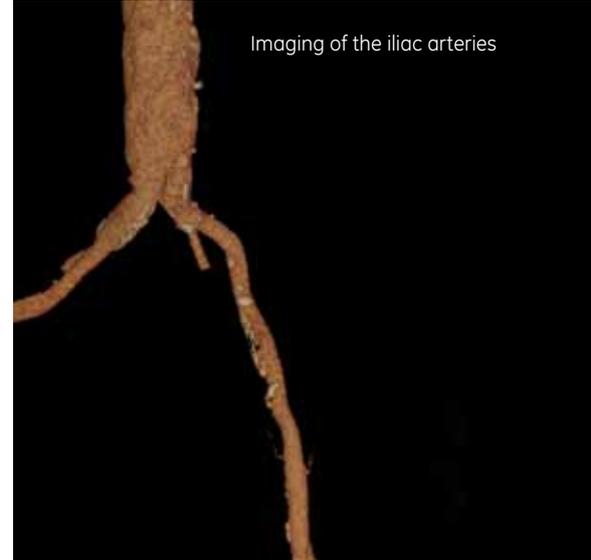
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Imaging of the visceral arteries



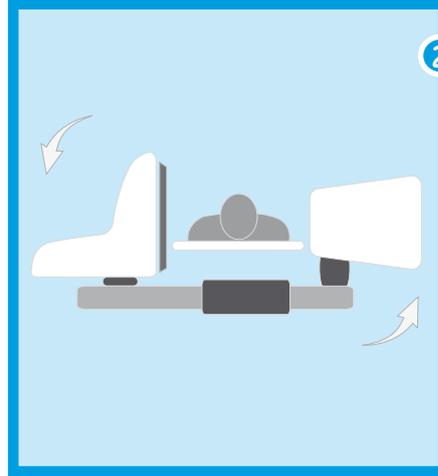
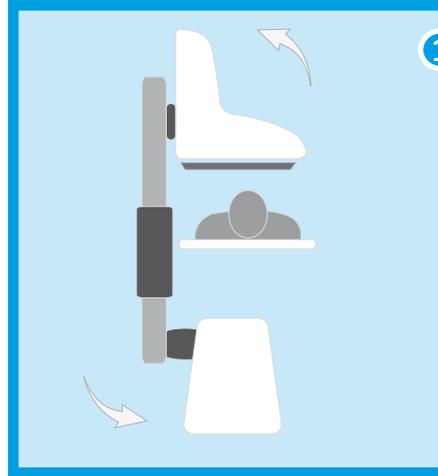
Imaging of the iliac arteries



The ostia of the renal arteries are visible



The ostia of the celiac trunk and SMA are visible



## Follow the gantry

As the C-arm is moved to image perpendicular to the vessels of interest, the 3D model automatically follows without the need to shoot X-ray. The table position can be adjusted to properly center the anatomy of interest in this new angulation. For infra-renal and thoracic EVAR, the targeted proximal landing zone can be drawn as a ring before the procedure and overlaid to help find the angulation perpendicular to the vessels.

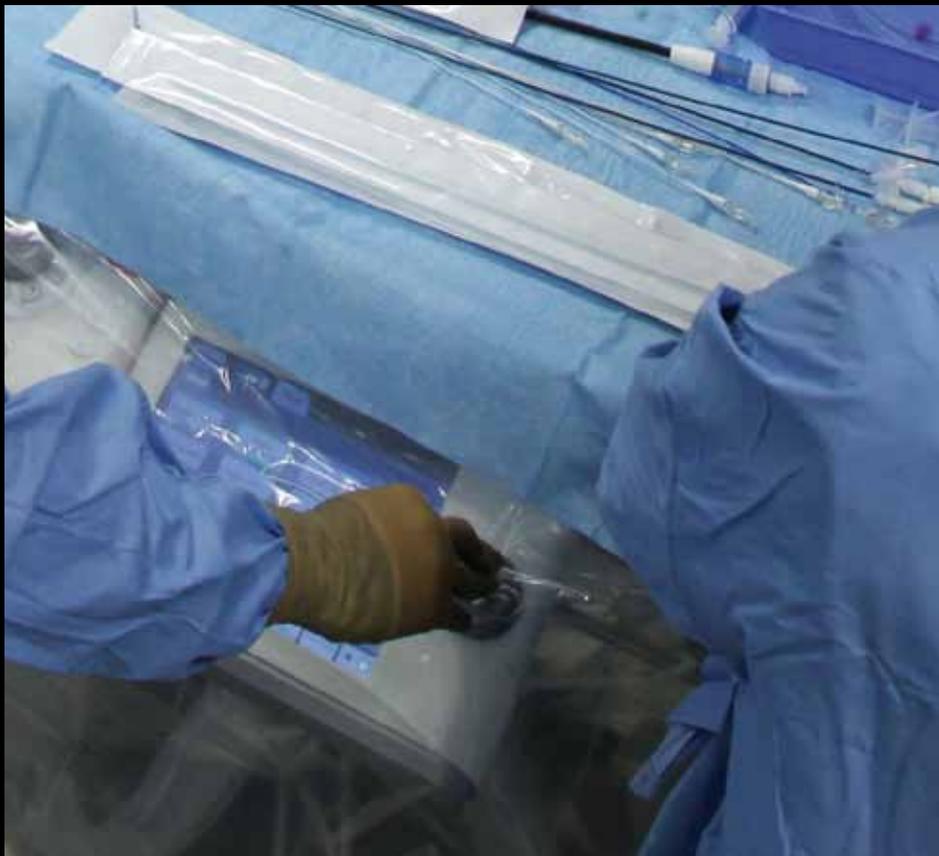


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## Fine tuning of the registration

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The position of the 3D overlay is fine-tuned to compensate for vessel deformations that may occur after the insertion of the endograft sheath. The targeted vessels on the CT overlay are aligned from tableside with the vessels visible on angiographic images.



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## Deployment of the endograft

The endograft is inserted under fusion guidance to help position the endograft at the right height and angle.



## Cannulation of visceral arteries

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Navigation into the ostia of the visceral arteries is done under guidance of the 3D fused images. In this case, cannulation through the four fenestrations was achieved in 30 minutes without any contrast media injection.





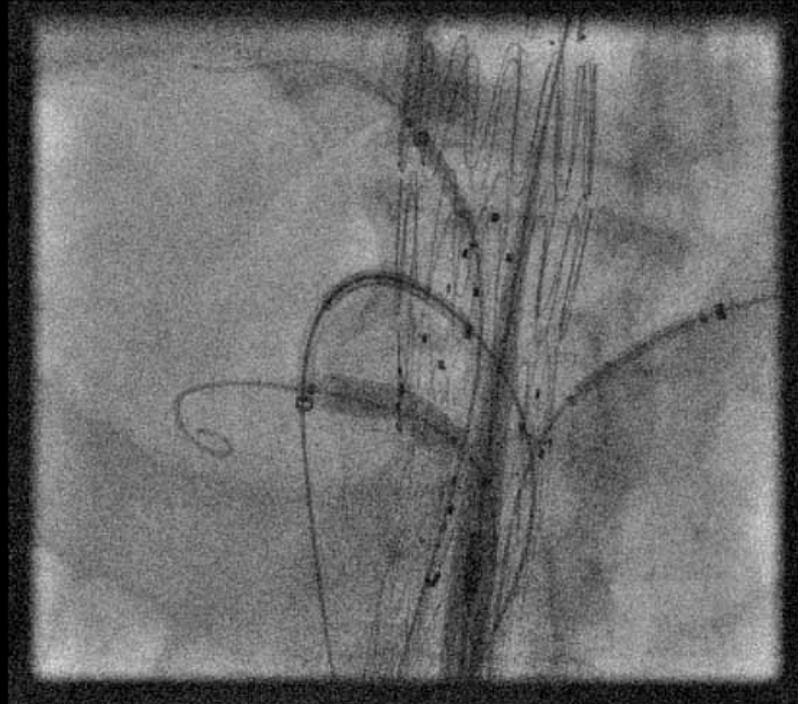
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## Deployment of the stents and endograft

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Angiograms are acquired to check the permeability of the visceral arteries after stent deployments.





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## Completion angiogram

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A completion angiography is performed to check for endoleaks.





## Cutdown closure

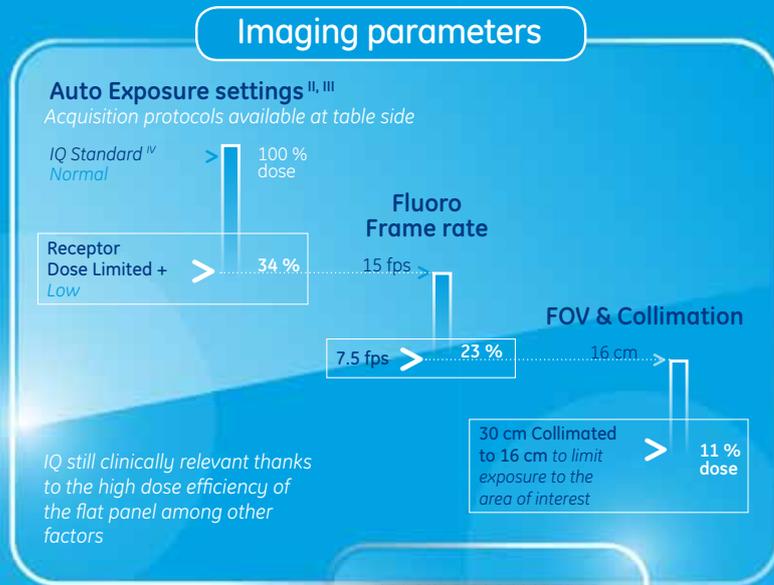
At the end of the procedure, the Discovery IGS 730 is positioned away from the table using the One-Touch Back-Out. This frees access to the patient's sides and facilitates the work of the surgeons closing the cutdown.

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# Dose management<sup>1</sup>



**IMAGING PARAMETERS  
USED IN THE DISCOVERY  
IGS 730 IN LILLE HELP THE  
TEAM TO REDUCE THE  
DOSE BY UP TO 89 %<sup>II, V</sup>**

Pr. Haulon's team at CHU of Lille uses multiple strategies of dose saving, resulting in a median Dose Area Product (DAP) of only 44 Gy.cm<sup>2</sup> (minimum 16 Gy.cm<sup>2</sup> - maximum 147 Gy.cm<sup>2</sup>) and median fluoro time of 34 min (minimum 18 min - maximum 67 min) during the first 25 procedures of complex juxtarenal and thoracoabdominal EVAR.

Median DAP of 233 to 697 Gy.cm<sup>2</sup> (5 to 15 times higher than in Lille) and median fluoro times of 35 min to 83 min are reported in the literature for this type of procedures<sup>1,2,3</sup>

I - In clinical use, the results of dose reduction techniques will vary depending on the clinical task, patient size, anatomical location and clinical practice.

II - Approximated Dose per IEC 60601-2-43 (20 cm PMMA phantom).

III - Only valid when the maximum fluoro entrance dose is not reached.

IV - Default settings of the aorta and aorta arch protocols of the Discovery IGS 730.

V - Compared to the default settings of the aorta and aorta arch protocols of the Discovery IGS 730 with 16 cm FOV.

In clinical use, the results of dose reduction techniques will vary depending on the clinical task, patient size, anatomical location and clinical practice.

## Applications & imaging modes

### Fusion imaging

Pr. Haulon gets 3D vascular map from the pre-operative CT without need to perform an intra-operative 3D acquisition (which generates 4.2 to 24 Gy.cm<sup>2</sup> of DAP according to phantom studies <sup>4,5,6</sup> and 37 Gy.cm<sup>2</sup> according to a study on patients<sup>7</sup>). If used, intra-operative 3D acquisition (cone beam CT) would represent an additional dose of 10% to 85% of the median total exam DAP measured in Lille.

Centering of the anatomy and optimization of the C-arm angulation is done without shooting x-ray by leveraging the capacity of the 3D mask to follow the table and gantry movements.

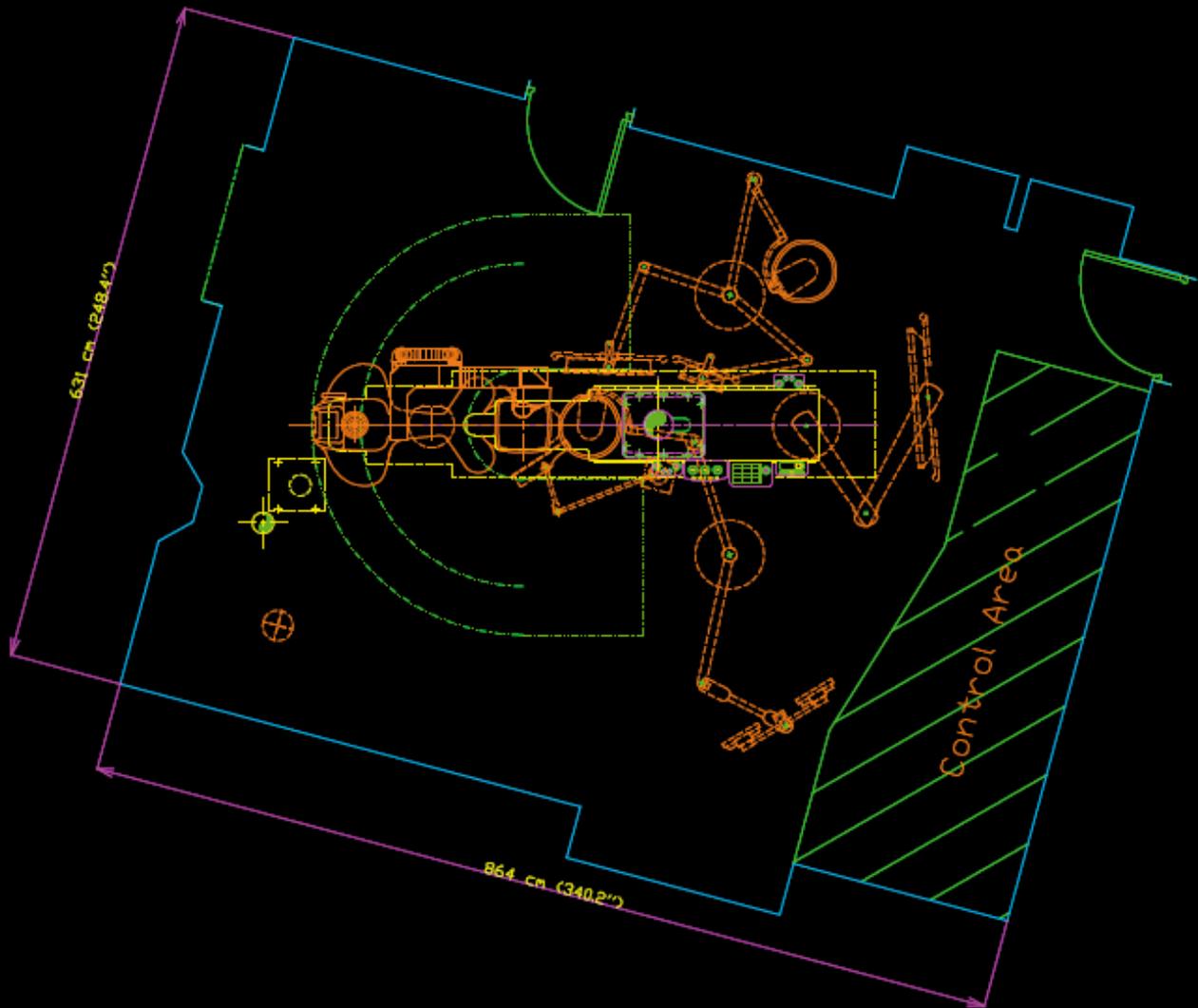
### Fluoroscopy

When clinically relevant, Pr. Haulon performs fluoroscopy rather than DSA runs. This applies, for example, to the roadmap imaging used during endograft legs positioning on the iliac arteries where the mask is acquired in fluoroscopy.

**USE OF INNOVA VISION  
WITH PRE-OP CT OVERLAY  
WITHOUT NEED TO  
ACQUIRE CONE-BEAM CT  
IS KEY ACCORDING TO THE  
SITE EXPERIENCE**

## Bibliography

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- 2 - G. Panuccio et al. Comparison of indirect radiation dose estimates with directly measured radiation dose for patients and operators during complex endovascular procedures. J Vasc Surg 2011;53:885-94.
- 3 - P. Howells et al., Risk of Radiation Exposure during Endovascular Aortic Repair. Eur J Vasc Endovasc Surg 2012; 43 : 393-397.
- 4 - Suzuki S. et al., Effective Dose during Abdominal Three-dimensional Imaging a Flat-Panel Detector Angiography System. Radiology 2009; 250 (2) : 545-550.
- 5 - Sangroh K. et al., Radiation dose from 3D Rotational X-ray imaging: organ and effective dose with conversion factors. Radiation Protection Dosimetry 2012; 150 (1) : 50 - 54.
- 6 - Suzuki S. et al., Evaluation of Effective Dose During Abdominal Three Dimensional Imaging for Three Flat-Panel-Detector Angiography Systems. Cardiovasc Intervent Radiol 2011; 34:376-382.
- 7 - Nordon I.M. et al., Validation of DynaCT in the Morphological Assessment of Abdominal Aortic Aneurysm for Endovascular Repair. J Endovasc Ther (2010)17:183-189.



# Configuration of the hybrid operating room

The room size is 58 m<sup>2</sup> (624 ft<sup>2</sup>), of which approximately 10 m<sup>2</sup> (108 ft<sup>2</sup>) is for the control room. It is equipped with:

- Discovery\* IGS 730 OR
- 2 Steris\*\* monitors suspensions
  - One on the left hand side of the patient with three monitors (Live, Reference and AW/MacLab\*), and 1 surgical lamp
  - One on the right hand side of the patient with two monitors (Live, Reference), and one surgical lamp
- Venue 40 ultrasound
- Aisys\* Carestation\* anesthesia delivery system
- 1 Dräger\*\* large monitor suspension that can be positioned either on the left or right hand side of the patient

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