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Cios Alpha: Flat Detector Mobile C-Arm Imaging in Advanced Endovascular Surgery

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Designed to Meet the Highest Requirements:

The Mobile C-Arm Cios Alpha

Surgeons rely increasingly on high-resolution, dynamic images during interventions – in all situations and with all patients. The mobile C-arm Cios Alpha from Siemens sets new standards in this respect. Professor Eike Sebastian Debus, Director of the Clinic and Policlinic for Vascular Medicine at the University Hospital Hamburg-Eppendorf, Germany, and current President of the German Society for Vascular Surgery and Vascular Medicine, has subjected Cios Alpha to intensive tests and reports on the experiences gained, specifically in the treatment of aortic aneurysms.

Text: **Matthias Manych** Photos: **Sven Doering**

Buzzwords like minimally invasive surgery, miniaturization, and demographic change are indicative of the increased demands now placed on operating room imaging. The development of stent technologies in the nineties considerably reduced the invasive nature and the complication rates of vascular surgery procedures. Implants and instruments are simultaneously becoming smaller and more precise. "Today, our enhanced technical armamentarium ensures that, compared with past statistics, those active in the field of vascular surgery only have to perform open surgery on a maximum of 60 percent of patients, while at least 40 percent are treated with stent technology, a figure which increases in individual areas such as aortic surgery," explains Professor Debus. As vascular morbidity increases with age, so does the proportion of patients with vascular conditions requiring treatment. It goes without saying that contemporary surgery options necessitate the presentation of structures in the millimeter range, power reserves and the intuitive, flexible operation of X-ray systems.

“Cios Alpha is the first mobile C-arm I know which satisfies all requirements.”

Prof. Debus, Director, Clinic and Policlinic for Vascular Medicine, University Hospital Hamburg-Eppendorf, Germany

Every millimeter counts – contemporary vascular surgery requires high-performance intraoperative imaging.

Square Substitutes Circle: More Details, Better Overview, Fewer Risks

Image intensifiers are beset by limitations pertaining chiefly to spatial resolution, image coverage, distortions, and gray scale resolution (dynamics). A prominent feature of the mobile C-arm Cios Alpha from Siemens is a flat detector which now replaces the round image intensifier – a square instead of a circle. This technology permits the visualization of details essential for endovascular aortic repair (EVAR). The stent designed to eliminate an aneurysm must be positioned with millimeter precision, and may under no circumstances impede blood flow to a renal or iliac artery.

Cios Alpha's 30-by-30-centimeter flat detector (FD) facilitates distortion-free images of the entire field of view (FOV), thus generating 25 percent more coverage. Debus clarifies the significance of these prosaic figures in practice: "These 25 percent constitute a colossal step forward. It is crucial to have a field of view as large as possible to evaluate the intraoperative image properly, particularly in the case of procedures performed on the aorta." And the FD technology provides an overview of more of the surrounding structures, in addition to the relevant section of the aorta. During an EVAR procedure, Debus and his team can now observe how contrast agents disperse in the renal arteries branching off from the aorta in the same field of view, and check whether an embolism or thrombus is present there. The flat

Aortic Diseases in Brief

Professor Debus, who is particularly at risk?
Debus: There is a clearly defined risk group which includes older men. The incidence rate increases considerably from the age of 60 and above. Smokers, hypertensive patients and those with a familial predisposition are also at risk.

Does this influence prevention?
Debus: Yes. Our specialist society concludes that, if we systematically screened older men aged 65 plus and women aged 55 and above with a familial predisposition or if they smoke, this would result in less emergency patients in Germany suffering ruptures. The corresponding treatment costs and the mortality rate would be reduced considerably in consequence. The screening process actually does eliminate the need for approximately 50 percent of emergency surgical interventions. We know this from studies in countries in which this type of screening is already established.

What does endovascular therapy need to succeed?
Debus: We are one of the centers which prefer to perform these interventions under full anesthesia, as we ensure that the stents are positioned with millimeter accuracy. This is particularly important because the precise fixation of the stents in the blood vessels guarantees secure prosthesis hold in the long term. The intervention requires a state-of-the-art X-ray system capable of displaying ultrafine details. Cios Alpha additionally includes technical functions which help us save on contrast agents. We can record a series of angiography images and retrieve them as subtraction images, reproduce them on the screen and use them to position the prosthesis with millimeter precision.

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Professor Dr. med. Eike Sebastian Debus

Before Professor Debus founded and built up the Department of Vascular Medicine at the University Hospital Hamburg-Eppendorf, Germany, from 2009 onward, he held the post of Head Surgical Physician at a municipal hospital in Hamburg. Debus is the current President of the German Society for Vascular Surgery and Vascular Medicine. The doctor implanted his first aortic stent in 1996. Although he now specializes in vascular surgery, he and his fellow clinicians subject the entire blood vessel organ system to comprehensive examination, from diagnosis to interventional and conservative treatments and physical therapies. 2,500 surgeries on the vascular system are currently performed at the clinic each year. These include between 200 and 250 aortic procedures, of which 75 percent take the form of stent treatments.

detector also significantly benefits patients unable to tolerate contrast agents as a result of kidney disease. Its high image resolution permits carbon dioxide instead of contrast agents to be used for these patients.

Staying Power for Long Procedures

Previous C-arms were sometimes pushed to the limits of their capacity during longer operations – one of the decisive challenges associated with interventions lasting several hours, as Debus explains: "The tubes in the earlier-generation C-arms overheated after a certain period, and the device switched itself off automatically to cool down. It was necessary to wait for a while before carrying on with the procedure. That was a significant problem." For obese patients, it sometimes even meant that what had begun as a minimally invasive intervention to repair an aortic aneurysm had to be continued as open surgery. Now, a 25-kilowatt generator provides the power required when the human anatomy needs maximum performance at short notice, while an active cooling system ensures that overheating and image quality degradation during long-lasting procedures are a thing of the past. Additionally, the distance between generator and detector has now been upped to 85 centimeters, with the result that the increased space above the operating table offers more space for surgical instruments and manipulations.

Operability – a Quantum Leap

Cios Alpha integrates additional technologies which eliminate many of the compromises required by intraoperative imaging. One problem which arises in surgical situations is that fluctuating staff members are not instructed sufficiently, or that commands from the operating surgeon are misunderstood. Debus knows from experience that "this always interrupts one's operating flow." This is why he is so enthusiastic about Cios Alpha's ease of use, which has, in his eyes, made a quantum leap as the operator can program and control procedures entirely independently from within the sterile field. He activates the device with a foot switch, subsequently controlling it completely via a touch screen mounted on the operating table, and uses touch-sensitive electromagnetic brake controls integrated directly in the flat detector housing to position the C-arm. In addition, a single-touch positioning function allows users to save specific C-arm projections and reproduce these later precisely – at the mere touch of a button. "This is advantageous when it comes to assessing renal arteries, for example, which may branch off from the aorta at different angles," says Debus. It certainly results in streamlined workflows.

Recent achievements by medicine and medical engineering, which endeavor to guarantee all patients excellent

results during complex interventions on ultrafine anatomical structures, present intraoperative imaging with a considerable challenge it is meeting head-on. Debus summarizes the experiences gained during the test phase with the mobile C-arm thus: "Cios Alpha is the first mobile C-arm I know which satisfies all these requirements."

Matthias Manych, a biologist, is a freelance scientific journalist, editor, and author specializing in medicine. His work appears primarily in specialized journals, but also in newspapers and online.

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Prof. Debus adjusts the C-arm by using electromagnetic brake controls integrated in the flat detector housing.

Case Study: Type B Aortic Dissection Intervention: TEVAR with the C-Arm Cios Alpha

Condition: The aortic dissection occurs via a tear (entry) in the innermost layer of the vascular wall (tunica intima), and the blood flowing into the tunica media splits the area between the inner and the outer vascular wall (tunica adventitia). A so-called false lumen is produced in the tunica media, which may displace or dislodge the actual one. Risk factors for aortic dissection include vascular malformations, vascular wall restructuring, inflammatory lesions, hypertension (frequently with arteriosclerosis), operations and accidents. Approximately three new cases of acute aortic dissection occur per 100,000 inhabitants annually. In the case of type A dissections, the "entry" is located in the vicinity of the ascending aorta while, in the case of type B dissections, it is situated below the left subclavian artery (descending aorta).

Patient: A 54-year-old man (body weight 115 kilograms, hypertension) suffered a type B aortic dissection in the wake of a motorbike accident, which had become chronic by the time the intervention was performed (according to the guidelines issued by the German Society for Vascular Surgery and Vascular Medicine, duration of symptoms exceeding 14 days).

Therapy decision: The large false lumen located directly below the left subclavian artery exit prompted the team around Prof. Debus to perform a thoracic endovascular aortic repair (TEVAR).

Intraoperative challenges: Precise stent graft positioning without overstenting of important vessels in the case of an obese patient. As far as imaging is concerned, high generator performance, high resolution, and large FOV are required. During surgery, the left carotid artery and subclavian artery exits are graphically marked (live graphical overlay) in the X-ray image displayed on the monitor via the touch screen mounted on the operating table in order to support precise stent graft positioning. The verification scan after stent graft placement shows that intra-arterial pressure has caused the stent graft to slip from its optimal position, with the result that contrast agent is still flowing into the false lumen. The operating team inserts a second stent graft between 1 and 2 centimeters nearer the left carotid artery with overstenting of the left subclavian artery.

Outcome: The entry to the false lumen was successfully covered by the second stent graft.

Cios Alpha is not commercially available in all countries. Due to regulatory reasons its future availability cannot be guaranteed. Please contact your local Siemens organization for further details.

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