Evaluation report

MEDTRON Accutron HP-D double head injector

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PREFACE

At Nantes CHU, a hybrid operating room (Flexmove, Allura, Philips) is reserved for a team of 6 vascular surgeons. Each surgeon is assigned operating sessions, primarily for endovascular work. Complex aortic and peripheral procedures are performed (branch, fenestrated and thoracic endoprostheses, multiple peripheral revascularizations), as well as more simple endovascular procedures.

In order to perform these interventions, the clinicians may use various imaging tools such as fusion imaging, which can be performed either using images from a preoperative scan, or based on an intraoperative injection with incomplete rotational acquisition. In this case, in order to obtain a usable image, the volume injected is calculated according to the duration of the rotation of the bed cradle, the nature of the artery to be made opaque, and the flow of the injection. The practitioner may also decide to test the action performed (for example, implantation of an endoprosthesis in order to exclude an aortic aneurysm) by performing a three-dimensional intraoperative test. In both cases, a high volume of product (contrast and serum) must be injected in order to achieve a high quality image. In the case of complex peripheral procedures, the volumes of contrast medium used are lower, but will accumulate throughout the intervention. Finally, irrespective of the type of procedure, the existence of any renal impairment will require the volume of contrast medium used to be limited. As a result, a limitation in the volume of contrast medium used throughout the intervention is a constraint that the vascular surgeon must take into consideration, irrespective of the type of arterial endovascular procedure envisaged.

The use of a double head injector makes it possible to reduce the volume of contrast medium injected, and at the same time to improve both radioprotection and the quality of the intraoperative graphics. Regarding the first point, the injector makes it possible to control the volume administered, in comparison to a manual injection.

In addition, the automated dilution of the contrast medium using a physiological serum also makes it possible to reduce the quantity of contrast medium injected. As regards the second point, the use of an automated injector allows the clinician to keep away from the source of the X-rays, and thus be protected from the radiation emitted during the creation of the graphics. Finally, automated injection is essential particularly during the aortic stage, in order to obtain high quality images while limiting the volume of contrast medium used.

Objectives

Using a variety of aortic and peripheral cases, we wished to determine the parameters that would allow us to obtain the best possible image quality, while reducing the quantity of contrast medium used. The MEDTRON Accutron HP-D double head injector has been evaluated by vascular surgeons for peripheral and aortic arterial endovascular procedures. The procedures were performed in a hybrid operating room (Flexmove, Allura, Philips). The quality of the images obtained was judged subjectively by two different clinicians, based on the angiography created. The parameters studied were the type of artery treated, the volume of contrast medium, the flow, blood products and finally the concentration of the contrast medium. The contrast medium used was Xenetix 300. In the case of renal impairment (clearance <60 ml/mn), Visipaque 270 was used. We here report on two cases of thoracic aortic procedures.

STUDY

Clinical case 1: Aortography prior to implantation of a thoracic endoprosthesis

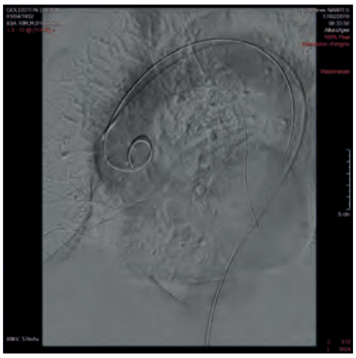
Clinical context

Mr G. is an 84 year old patient. He has an aneurysm of the descending thoracic aorta, which luckily was discovered. Endovascular treatment was applied, using a covered endoprosthesis. As the scan indicated, the proximal coverage zone had to be applied at the base of the left common carotid artery, thus covering the left subclavian artery.

Meticulous intraoperative work was therefore required to locate the supra-aortic trunks. For this patient, we evaluated various protocols that would make it possible to minimize the injection of contrast medium, for better visualization of the aortic arch and its branches.

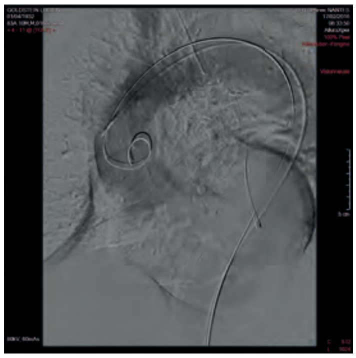
Protocols

Allura flat panel detector in the head position with bidimensional acquisition (subtraction: 3 images/s). The injection was performed using a 5F multiperforated pigtail catheter.



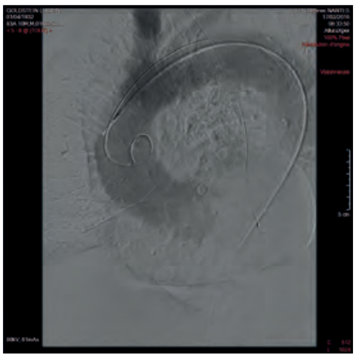
Acquisition 1.1

Visipaque 270, volume: 30 ml, diluted mode (concentration 30 %), flow: 20 ml/s, injection delay 0 s, duration of acquisition: 2 s, blood product: 1200



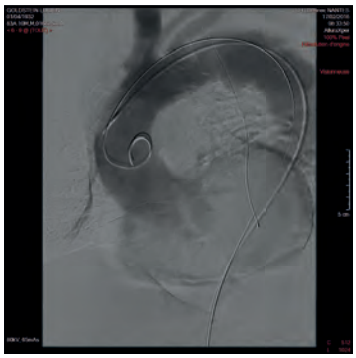
Acquisition 1.2

Xenetix 270, volume: 30 ml, diluted mode (concentration 30 %), flow: 30 ml/s, injection delay 0 s, duration of acquisition: 2 s, blood product: 1200



Acquisition 1.3

Xenetix 270, volume: 30 ml, diluted mode (concentration 40 %), flow: 30 ml/s, injection delay 0 s, duration of acquisition: 2 s, blood product: 1200



Acquisition 1.4

Xenetix 270, volume: 30 ml, diluted mode (concentration 50 %), flow: 30 ml/s, injection delay 0 s, duration of acquisition: 2 s, blood product: 1200

Results (Images 1.1, 1.2, 1.3 and 1.4)

In the 4 successive injections, the volumes of contrast medium injected were 9, 9, 12 and 15ml respectively. Between the 1st and 2nd acquisitions, the definition of the thoracic aorta improved but the origin of the supra-aortic trunks remained unclear. From case 3, the contours of the thoracic aorta were correctly defined but there was no clear distinction in the origin of the supra-aortic trunks. With the final acquisition, the thoracic aorta and the origin of the supra-aortic trunks were perfectly well defined.

In comparison, with a single body injector, this result was routinely achieved with the injection of 30ml of undiluted contrast medium.

Clinical case 2: Thoracic endoprosthesis test

Clinical context

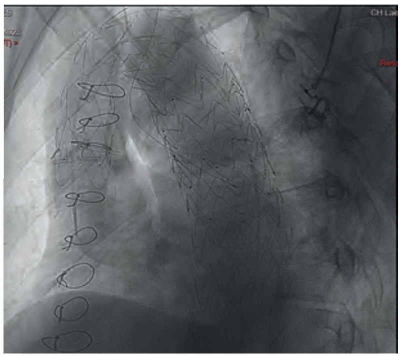
Patient of 49 years of age, referred for endovascular treatment for a type 1 thoracoabdominal aneurysm complicating an aortic dissection. The patient had previously benefited from 2 interventions in the weeks prior to this procedure (left carotid-subclavian transposition, then replacement of the aortic arch associated with transposition of the brachiocephalic arterial trunk and the left carotid artery).

Protocols

The endoprosthesis was implanted under fusion based on the preoperative scan. At the end of the intervention we chose to perform an arteriogram to test the efficacy of the implantation of the endoprosthesis by means of three-dimensional acquisition.

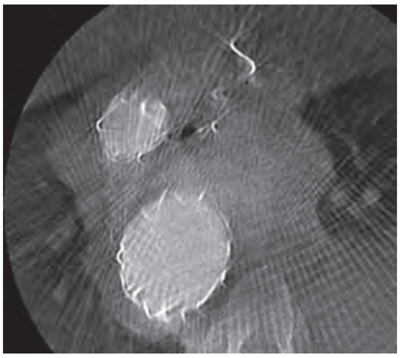
Acquisition 2.1

Allura detector acquisition protocol in lateral position, three-dimensional acquisition (acquisition time: 8 s, 180 rotation, resolution 15 images/s). Injection performed using a 5F multiperforated pigtail catheter. Xenetix 300, volume: 120 ml, diluted mode (concentration 50 %), flow: 10 ml/s, injection delay 4 s, blood product: 1200

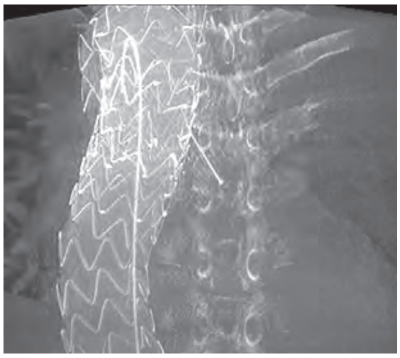


Acquisition 2.2

Allura detector in the lateral position (acquisition time: 8 s, 180 rotation, resolution 15 images/s). Injection performed using a 5F multiperforated pigtail catheter. Xenetix 300, volume: 140 ml, diluted mode (concentration 60 %), flow: 18 ml/s, injection delay 0 s, blood product: 1200



Acquisition 2.3



Acquisition 2.4

With protocol 1 (Image 2.1), the volume of contrast medium injected is 60 ml. We can observe lesser intensity and increased heterogeneity from the injection of the contrast medium into the thoracic aorta. It is noteworthy that the lateral position of the bed cradle requires a longer acquisition time than in the head position (8 s versus 4 s) and therefore a higher quantity of contrast medium injected. According to these observations, the decision was made to increase the volume and concentration of the contrast medium.

With protocol 2 (Image 2.2), the volume of contrast medium injected was 84ml. The contrast medium was observed to be more evenly distributed along the thoracoabdominal aorta with improved intensity. The quality of the injection facilitated a scan-type coronal and frontal section analysis (Images 2.3 and 2.4).

Intraoperative three-dimensional analysis of the result of the implantation of a thoracic endoprosthesis appears to be possible with reduced doses of contrast medium. A head position in the flat panel detector would make it possible to significantly reduce the volume of contrast medium to be used.

DISCUSSION AND CONCLUSIONS

Advantages

In the cases presented, the dilution of the contrast medium achieved by means of the MEDTRON Accutron HP-D double head injector made it possible to use lower quantities of contrast medium. The volumes of contrast medium appear to be lower than those normally used with a single body injector. The reduction in volume of the contrast medium, together with the use of fusion, make it possible to limit the risk of deterioration of renal function in at-risk subjects. In subjects without a renal impairment risk factor, rotational acquisitions before and after the procedure can be envisaged which limit the volume of contrast medium used. Dilution can also be performed using a single body injector, but in this case we observe a loss of homogenization in the 2 phases (contrast/serum) during the procedure, making the injections heterogeneous.

In addition, in the case of rotational acquisition, installation at the head of the detector makes it possible to reduce the volume injected. In fact, both the quality and the speed of acquisition of the images are superior with a detector in the head position (acquisition time: 4 s, 260 rotation, resolution 30 images/s versus acquisition time: 8 s, 180 rotation, resolution 15 images/s).

Finally, the MEDTRON Accutron HP-D double head injector could be used with other types of injections, such as injection per phase (alternation of blood product and physiological serum) or complex injections (dilution and phase), which might improve the protocols described here still further.

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Limits

Certain limitations to the uses of the MEDTRON Accutron HP-D double head injector may be noted. First, the injector is only available on a wheeled frame; it cannot be attached to the operating table. The ergonomics of the operating room may not be optimal. However, the MEDTRON Accutron HP-D double head injector is mobile and operates autonomously with a battery supply, with a wireless command and monitoring system; this provides the advantage of being able to move it into another room if necessary.

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