The new age of endovascular surgery planning

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"We should learn how to use new tools properly and gradually identify new benefits."

Editorial

In vascular surgery, we have definitively entered the digital age, leaving the age of calipers behind. Disruptive technology is a new term that describes the technological innovation, a product or service that displaces current technology, unlike the revolutionary innovations that introduce a technology for higher performance in the market[1]. We should learn how to use new tools properly and gradually identify their new benefits.

Today, we have several diagnostic methods available that generate huge amounts of information; this way, the old medical analysis of negatoscope images is becoming obsolete. X-ray imaging visualization was properly provided by the negatoscope, but, with the advent of tomography and magnetic resonance, the images started to be precise in axial (coronal or sagittal) cross-sections, requiring more and more printed sheets. It makes it difficult to analyze the exam, increases the exam cost and pollutes the environment.

Computed tomography (CT) and magnetic resonance (MR) continue to evolve, generating more information, with thinner and more cross-sections. What could be presented before in tens of axial cross-sections, now employs thousands of cross-sections. In addition, the almost infinite possibilities of multiplanar reconstructions that allow oblique cross-sections have made it obsolete the analysis of printed images only.

3D volume reconstruction, already in use, is an analysis technique that add up data from all axial cross-sections and summarizes them in few images. The relevant information can be quickly printed in a few pages, but it is not reliable for more accurate analysis, such as diameter and distance measurements, which are very important in endovascular surgery planning. Other reconstructions, such as orthogonal, multiplanar and curved planes, were developed to fulfill such demand, allowing very precise measurements at angles never imagined before.

In the past, 3D reconstruction was restricted to dedicated computers called workstations, very expensive and limited to radiology use. However, with the evolution of personal computers, it is possible to have, at home, in the emergency room, in the outpatient care unit, or even in a mobile, a computer al-

most as powerful as a workstation dedicated to medical images and capable to create images of amazing quality and speed.

The big question, a while ago, was the almost nonexistence of a software program suitable to DICOM image analysis for personal computers; the few available were very expensive and not accessible to the common user. Most physicians have already tried the limited software programs supplied in the exam CD and were surely frustrated with the experience. The website I Do Imaging (http://www.idoimaging.com/) offers many free programs for download that can run under any operating system; among these, OsiriX is our recommendation.

The evolution of hardware and software has also allowed higher portability, with the use of tablets or smartphones (iPhone), which have a hand-held version of OsiriX, providing one more option of imaging visualization in any environment, for instance, in the operating room.

Recently, Ratib and Rosset developed OsiriX to run on the Mac OS X platform, which is an open-source software, i.e. free and that allows modifications (http://www.osirix-viewer.com)[1-3]. It provides the common user with most tools available in the powerful workstations, from quick visualization of axial images without modifications to advanced editing of 3D reconstructions through volume or surface rendering and oblique multiplanar reconstructions. As it was developed using 3D game routines, it is very fast, even in very heavy tasks. It was precise in the visualization of small vessels in critical areas, such as the artery of Adamkiewicz, when compared to complex workstation systems[4].

Its great benefit in daily practice is to make it easier the visualization of medical images, which can be presented in a CD, instead of printouts. The hospital expenses with x-ray exam printing are drastically reduced and it is good for the environment. Besides, the CD keeps the original quality of the exam, and, rather than having only some printed images, it is possible to have all original images stored. For these reasons, when requesting an exam, be sure to ask “the DICOM images recorded in a CD”.

DICOM (Digital Imaging and Communications in Medicine) are regulations created to standardize, even in different devices, the format of diagnostic images, such as tomography, magnetic resonance, radiography, ultrasound, etc. DICOM is a standard comprised of several regulations that allow to exchange medical images and associated information between imaging diagnostic devices, computers and hospitals.

The first surgeon that used OsiriX as a tool for surgery planning and who published his experience was Sugimoto, an expert in digestive tract surgery. He used 3D reconstructions in his personal computer to perform his laparoscopic surgery later with more convenience and no surprises[5].

Since then, other medical specializations have adopted this image viewer.

By using this software program, plastic and maxillary surgeons make 3D reconstructions that contribute to easier face reconstruction operations. Urologists, digestive tract surgeons and cardiac surgeons can better plan a laparoscopic or robotic surgery. In addition, it is possible to virtually perform endoscopy, colonoscopy and bronchoscopy, as well as many other types of exam[4-7].

OsiriX has enabled the expert physicians’ independence from radiologists in medical image visualization. Such independence is more evident in emergency units, where it is not necessary to wait for the radiologist anymore, allowing the attending physician to make important and urgent decisions quickly. On the other hand, radiologists too have increasingly used the Apple platform, due it its high stability and portability.

The possibility to act on the medical images with 3D and multiplanar reconstructions allows a more detailed analysis at unusual angles of human anatomy and its surface. It contributes to easier lessons to students of medicine or other health sciences, not requiring dissection of cadavers.

Especially in vascular surgery, these images can be used in endovascular procedure planning, which requires measurements of absolute precision. Before performing a percutaneous procedure, it is recommended to make one's own measurements, rather than have the surgical procedure based on measurements taken by others not directly related to the patient and the procedure, although it has been until now the most frequent solution. For those who made their own measurements, the solution available until some time ago was the use of calipers and rulers, combined with much patience and faith, or else going to the radiology department to use the workstation.

However, no solution offered the physician freedom for a proper and unlimited imaging analysis.

While the 3D reconstruction summarizes data from few pleasant and impressive images, the great resource of OsiriX is the multiplanar reconstruction, enabling measurements at any angle, which are extremely useful in endovascular planning. The vessel diameter and length can be actually calculated, instead of using approximations of tangential cross-sections. The knowledge obtained with the new tools of imaging analysis resulting from the technological evolution is essential for a successful operation.

Although this program is intuitive and its basic functions are simple, its complex functions would require a dedicated book on the subject, which, due to constant updates, would be always out of date. Today, several trainings are provided worldwide to teach how to use this intriguing image viewer, especially to physicians that were used to calipers.

The time in which the patient's anatomy had to adapt to the grafts available and the techniques had to be juggled to adapt them to the case, resulting in a "clothesline" of hanging vessels, is about to end, giving place to a careful planning before the endovascular surgery, in which the analysis of arterial measurements is essential for the selection of the graft to be used. The situation is inverted and selection of devices is based on the patient's real needs. This is a fact that confirms the nonexistence of equivalence in endovascular devices and that, the more we know about the particular characteristics of each endograft, the better we will be able to indicate its use. A planning fault leads to a fault planning.

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