Leap Into Future In Image Navigation Neurosurgery: Visit to the BrainSuite at King Fahad Medical City in Riyadh, KSA

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Citation

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Abstract

This is a combination of visit and exploration of the BrainSuite operating room at KFMC in order to get acquainted with new terminology used and link it to the parts of system it indicates. Although there are many systems in the world, this is the seventh and the first in KSA and may be the second in the Middle East. It indicates a leap in the future for those fortunate doctors and patients who are using these exceptional facilities.

INTRODUCTION

The new neurosurgical operating room (OR) has been installed in the main hospital at King Fahad Medical city. It has been big advance scientific and surgical ground. It is an advanced technology for image navigation surgical precision. It carries with it patient care a step higher in the level of integration of computing investigation information collection in OR. No more fear from MRI big machines and traveling to it for further investigation after neurosurgery to confirm what was done or if the tumor was removed totally. The surgeon may do a preoperative IMR and then surgery through image navigation visualization of the mass of the brain. With this he will be more precise in this environment.

Figure 1

Picture 1: The control screen which can give access to patient's information registered inside OR, a copy of surgical process and iMRI navigation. The three dimensional (#D) figure is reconstruction of the head of a volunteer which allow examining at click of mouse and moving in all direction over an axis

Figure 2

Picture 2: Examining the skull as it rotates in the all direction by the author (MSMT).

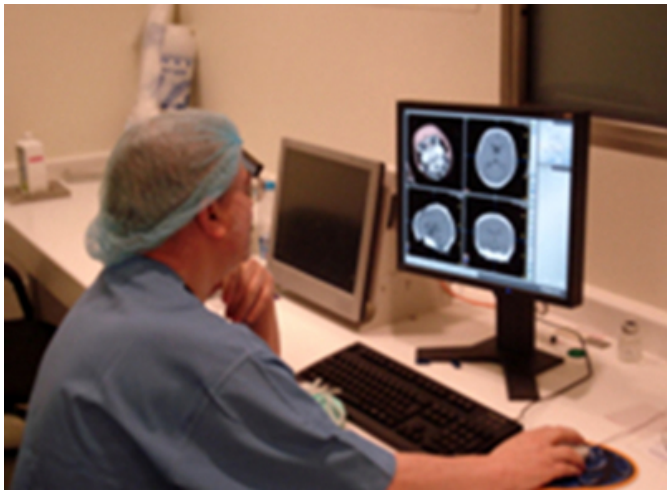


Figure 3

Picture 3: Suspended screen allow touch to operate in a spacious OR anesthesia and surgery side

Figure 4

Picture 4: MRI from surgical and anesthesia side shown a line on the floor where operating table would move to perform an MRI during surgery and under general anesthesia

Figure 5

Picture 5: Anesthesia machine with suitable monitoring of gases mixture, inhalational vapors, patients parameter and a very long expandable disposable sterile circuit examined by MSMT

Figure 6

Picture 6: In controlled lighting and under microscopic vision integrated information would guide the action with laser. This will allow t improve precision and reduce the effect of during surgery.

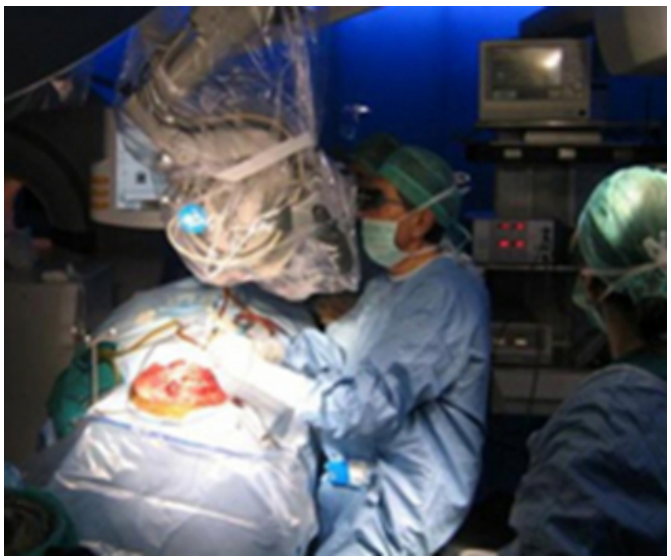
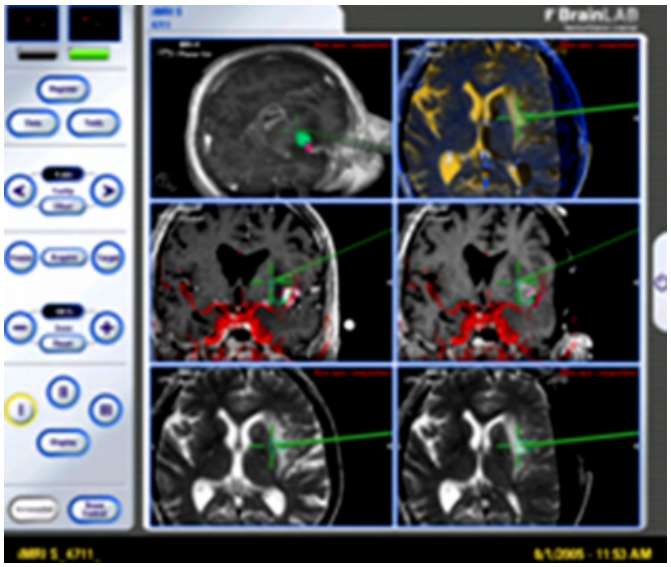


Figure 7

Picture 7: The intraoperative images appear as integrated images in all screen and on major wall screen showing the MRI images and operative microscopic pictures



DESCRIPTION OF

The operating room is spacious and can accommodate the tools which are needed to have precision neurosurgery for benefit of the patient.

1. The BrainSuite iMRI was first launched at the American Association of Neurological Surgeons (AANS) trade show in Chicago in April 2002. “Around the same time, the first installation of BrainSuite iMRI was at Erlangen University in Germany.”

2. The key components of the BrainSuite iMRI include:

    a. VectorVision sky iMRI Navigation System: which means the main apparatus camera and touch screen.

    b. VectorVision software including Automatic Image Registration

    c. Microscope [Zeiss, or Leica or Moller Wedel …]..

    d. BrainSuite Data Billboard [wall screen] and Data Management System

    e. BrainSuite iMRI system: high-field MRI scanner [1.5 Tesla (Siemens Magnetom Espree)]

    f. Rotating Operating Room (OR) table with integrated head clamp and coil

    g. OR lights including integrated video camera, ceiling supply unit, and anesthesia equipment

    h. BrainSuite iMRI RF shielded OR cabin.

The integration of these components results in a powerful neurosurgical OR. So images come from the iMRI and transferred in real-time to the navigation system, which acts like a global positioning system for the human body. This technology enables target mass of brain tumors, for example, to be localized with extreme accuracy. It also enables the neurosurgeon to decide what trajectory to take to access the tumor and to avoid highly functional areas of the brain. the VectorVision sky navigation system guides the neurosurgeon's instrument with an infrared laser, while the surgeon simultaneously follows the procedure under microscope, focused on full mass of the tumor. What makes this system special is the high-field iMRI. Intra-operable MRI has been around for a while, but they have been low-field MRIs. The 1.5 Tesla and higher field MRI is in effect a functional-MRI (fMRI) enabling instant and continual updating of the tumor position. This is particularly important

in neurosurgery, as there is what is called ‘brainshift'. The brain changes shape during surgery and it is essential the co-ordinates of the tumor are continually updated to ensure precise and accurate surgery. This is also necessary for tracking other important centers of the brain. The high-field MRI and new software from BrainLab enables diffusion tensor magnetic resonance imaging (DTI) with fiber tracking. This enables the neurosurgeon to follow, for example, the pyramidal tracts – motor nerve pathways in the brain and spinal cord – to see how their position changes during surgery and how to avoid damaging them.

THE DATA BILLBOARD

The BrainSuite's Data Billboard provides the entire OR team clear access to all clinical data through an advanced visualization design to enhance surgical decision-making processes. The central device for controlling all instruments in the BrainSuite is the touch screen. On the touch screen surgeon can follow his navigation, display the images of the microscope, control the data billboard and room control system as well as the OR lights. All these features can also be controlled from a wall mounted touch screen outside the sterile field or from the control room outside the BrainSuite. BrainLAB says standard surgical instruments can be used as the operating field is situated outside the 5 Gauss line.

Also, the MRI magnet is actively shielded. In other words, within the magnet, a secondary magnetic coil of opposite polarity is positioned outside of the main magnetic coil. The secondary coil greatly reduces the magnetic fringe field that extends into the area surrounding the magnet. The 5 Gauss line is: “Around the magnet there is a magnetic fringe field which becomes weaker the further you move away. The 50 Gauss line indicates the distance to the magnet from which things can be actively pulled to the magnet. The 5 Gauss line is further away from the magnet and is called the pace-maker line. People wearing pace makers should not come closer to the magnet than this line, which is marked on the OR floor. “Operating in the BrainSuite takes place outside the 5 Gauss line since the head of the patient on the OR table is positioned outside this line.

Therefore regular surgical instruments can be used. The instruments will not be attracted to the magnet and sensitive electronic devices work properly.”

WORKFLOW

The sophisticated design of the BrainSuite iMRI is complemented by an efficient workflow system, starting with BrainLab's iPLAN treatment planning software to “markerless patient registration and navigation-ready surgical instruments.

The iPLAN software enables doctors and treatment centers to effectively use the massive amount of information available to them as well as giving them remote, multi-user access so that data can be viewed from outside the OR, at home or at the patient's bedside where 3D renderings can be used to refine or explain a surgical approach.

BrainLab's Z-Touch markerless patient registration offers a fast, reliable and accurate solution for patient registration. The company declares more than 70% of its VectorVision navigation procedures are registered with Z-Touch. Also it has invented a combination of navigation-ready instruments to ensure faster setup and optimized surgical workflow.

Other components like anesthesia machine, instruments and other supporting items are specially designed to work near magnetic field in order to provide safety and compatibility.

CONCLUSION

It is a very exciting to see this brain child of many clever industries focusing on wellbeing of sick patients and make window of hope to neurosurgical patients in KSA.

ACKNOWLEDGEMENT

The authors would like to indicate that some words are stuck together in the text to indicate a process or machine and came bold and in italic in the text and they are not topographical errors. Operative pictures are offered BrainLab company courtesy of L. Ferrante and L. Mastronardi, Ospedale Sant Andrea Rome, Italy. The other pictures are from KFMC Main theatre.

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