The Sahlgrenska University Hospital Multidisciplinary Hybrid Room

Sahlgrenska University Hospital is one of six teaching hospitals in Sweden. It provides specialized care for the 1.7 million inhabitants of West Sweden and basic care for the 700,000 inhabitants of the Gothenburg region. AXIOM Innovations spent 3 days with the team observing cases and talking about their multidisciplinary experience.

The Gothenburg multidisciplinary journey began in approximately 1996 when the vascular surgeons of that time recognized the benefits of a hybrid operating room. This idea started to become more concrete in the early 2000s when Sahlgrenska University Hospital (SUH) envisaged a new interventional imaging building with some rooms earmarked as hybrid OR. With traditional Scandinavian planning and attention to detail, it was decided to make a comparably small investment and install an Artis zeego in the established operating theater complex so they could understand the process, learn from the experience and limit the mistakes in their new multi-lab installation. In this pilot hybrid lab, over the past two years nurses, cardiologists, vascular surgeons, spine surgeons, interventional radiologists, and anesthetists have evolved their workflows and communication to work in harmony.

Planning the Pilot Hybrid Operating Room

As soon as the multi-hybrid lab proposal became more than just a dream, Karin Zachrisson, doctor of interventional radiology, and Håkan Roos, doctor of vascular surgery at Sahlgrenska University Hospital, wanted to work together to ensure the needs of both vascular surgery and interventional radiology could be realized. It is in no small part due to their efforts that the hybrid OR has had such a successful start.

The pilot hybrid OR was originally one operating theater and two adjacent rooms that were combined to make a 100 square meter room. The Artis zeego and Siemens OR table were installed diagonal to the walls so that in the most common working position (table at 15˚ to patient’s right, Artis zeego from patient’s left) the table is parallel to the walls and the anesthetists have the maximum amount of space at the patient’s head. Two large displays on both sides of the tables and two additional monitors on each side of the room were positioned so that all staff have an optimal view on the intraoperative and preoperative images as well as the vital parameters. A laminar airflow field providing the highest hygienic standards was installed along with additional ambilight for a better contrast on the monitor displays.

Team Work from the Beginning

Before the installation of the Artis zeego, SUH created an OR education group headed by Christina Ekroth who has a background as an OR nurse. In a two year collaboration between Siemens and the hospital an education plan was produced. This had the aim of introducing the different groups (assistants, nurses, interventionalists and anesthetists) to the hybrid room concept and the advantages for their patients. Ekroth, Dr. Roos and Dr. Zachrisson all stress that training and communication are both key to a smooth hybrid OR beginning. Ekroth recommends having a vision of what you want to achieve and clear your mind of preconceptions about workflow. “Working in a hybrid room is challenging and requires you to adapt and be flexible. People who say ‘we want to do it this way because we’ve always done it this way’ will not be able to benefit from all the advantages of a hybrid OR.”

The majority of the interventionalists were familiar with the Siemens systems that are in different departments of SUH. The transition to the Artis zeego was easy with just one extra joystick to control the robot. For those surgeons who were unused to angiography systems the learning curve was a little steeper. A “couple of months” is often cited as the amount of time it takes to be fully accustomed to the Artis zeego if starting with zero Artis experience.

Interventional Radiology

The interventional radiologists are led by Dr. Karin Zachrisson who has been an interventional radiologist for 20 years and at SUH for ten years. She and her team perform vascular, embolization, and TIPS procedures on the Artis zeego and highlights that it is mainly used for procedures where the patient is at high risk of uncontrollable bleeding. On inter-specialty interaction Dr. Zachrisson stated; “One of the most unexpected but rewarding advantages of the hybrid lab is the improved collaboration between IR and other departments. We always had a strong relationship with the vascular surgeons but for example once we started working with the cardiologists helping them with fusion on the Artis zeego during TAVI (trans aortic valve implantation) cases, we found that they also sought our opinion for cases such as renal denervation. We grow from this cross specialty interaction.”

Cardiac Interventions

The cardiologists regularly perform TAVI procedures in the hybrid lab to
All planned EVAR procedures are performed in the hybrid OR.
take advantage of the sterile conditions and of the proximity of their thoracic surgery colleagues. The thoracic surgeons assist with direct aortic and subclavian approaches, but for transfemoral approaches, they mostly work alone. The interventional cardiology team of Truls Råmunddal, MD and Petur Petursson, MD are yet to use their syngo Aortic ValveGuide software routinely as the CoreValve placement has a margin of error, but with the increased attractiveness of anatomically specific valves, correct placement will be greatly assisted by 3D imaging with motion correction.

Dr. Råmunddal agrees with Dr. Zachrisson that only specific cases are appropriate for the hybrid OR. “The vast majority of cardiac interventional procedures should be performed in the traditional lab. TAVIs and mitral valve interventions are exceptions. Currently we use the hybrid room for two cases every Wednesday. This may change in the future but for now it suits us."

When asked about the benefits to his patients, Dr. Råmunddal said, “Here at Sahlgrenska we perform TAVIs exclusively on patients who are unsuitable for conventional heart surgery. However, most patients are still candidates for surgical management of complications when needed. We strongly believe that the hybrid OR facilities make the TAVI procedure safer. For example, in the case of life threatening complications such as cardiac tamponade due to rupture of the left ventricle, we can have the chest open in under ten minutes and possibly fix the problem. The hybrid lab provides our TAVI patients with a bigger safety net because of the immediate access to vascular and thoracic surgical expertise.”

Vascular Surgery
Dr. Håkan Roos adopted the hybrid room concept from his predecessors and it is under his leadership that it has come to fruition. “It’s an obvious advantage to the patient when you don’t have to weigh up the risks of moving a patient in order to convert to open surgery,” he says. “In the hybrid lab, open surgery and interventional procedures are interchangeable.” The entire spectrum of vascular interventions is performed. Complex procedures with fenestrated or branched stents are now feasible in a setting like this and have become standard for vascular surgeons.

A technique that the vascular surgeons are refining combines five seconds syngo DynaCT and syngo InSpace 3D/3D Fusion in order to overlay anatomical markers during EVAR procedures (Fig. 1). Interventional radiologist, Giuseppe Koutouzi, MD regularly joins the vascular team to assist with post processing and fusion on the syngo X Workplace.

In the beginning of the hybrid lab journey, the vascular team assisted the cardiac team to learn certain skills needed during TAVI procedures. The 18Fr aortic valve delivery system sometimes requires dilatation of the iliac artery, a skill that the vascular surgeons shared with the cardiologists.

Spine Surgery
The orthopedic spine surgeons came rather late to the Artis zeego party. In 2011 spine surgery (along with pulmonary, orthopedic, and renal surgery) had not been considered as an area that would hugely benefit from using the Artis zeego, but in hindsight, the increased power and Autopan functionality make it far superior to the old-style mobile C-arm systems that spine surgeons used to use.

As the room was not being fully utilized by the IR and vascular teams, the spine surgeons were invited to use the hybrid lab on Mondays and have not looked back since. “The opportunity to have access to a room with an imaging system like the Artis zeego is of great value,” says Per Wessberg, MD.

Dr. Wessberg was excited by the image quality and started to use the hybrid operating room for complex spinal procedures. “For adolescent scoliosis procedures the Artis zeego brings surgery to a new level.” With a portrait syngo DynaCT and its excellent spatial resolution he is now able to place spinal implants very precisely. On top of this, if a screw is not in the ideal position it can be corrected there and then. A syngo DynaCT at the end of the procedures helps the surgeon to end surgery knowing that all screws are placed optimally.

For this final 3D acquisition, SUH is using the low-dose protocol 5s DR-L that requires only 30% of the dose of a regular 5s DR protocol. For very young patients SUH is evaluating a special protocol that acquires only half the number of projection images, thus even further reducing the dose by a factor of two. The surgeons mainly use the 3D volume for control of the screw placement and as a result routinely use under 30 seconds of fluoro for scoliosis and fusion cases.

The Hybrid Nurse
Monika Wass is an OR nurse with over 20 years of experience at Sahlgrenska. She has found it challenging but interesting to amalgamate with the IR nurses. “The IR nurses were interested in evolving their sterile technique and we have learned more about handling catheters and wires” says Wass, “in the beginning we had many meetings and practiced simulated cases but nothing can 100% prepare you for the first live case. You need to be very flexible and open minded and even after two years with the Artis zeego, we still learn new things.” Roos mentions that the long term goal is for nurses from either background to evolve towards becoming “hybrid nurses”.

Although the global trend is moving toward interventional procedures, Wass warns nurses to keep up their surgical skills. “When an interventional procedure goes wrong, the patient can go downhill very quickly. At this time the physicians need an experienced and competent surgical nursing team by their side. Stay current,” she advised.

Future Perspectives
The hospital regularly organizes “Intro days” where clinicians doing a wide variety of procedures (such as trauma and tumour surgery) are invited into the hybrid lab and shown the features of the Artis zeego that would benefit their specialties. Advantages common to all specialties include Autopan,
syngo DynaCT, the increased power of the angio tube and the potential for radiation reduction. Apart from those already mentioned, the current hybrid OR users consider that other specialties who could find the room useful include; the transplant team, gastro-enterology, gynecology, oncology, interventional neurology, neurosurgery, orthopedics, urology, and thoracic surgery. Some of these other specialties will begin their hybrid room experience upon completion of the new hybrid rooms.

If asked what changes they would suggest for a new lab, small modifications were discussed by the different teams. Dr. Roos and Dr. Zachrichsson wish for an operating table, like Trumpf or Maquet, whereas the cardiologists prefer the floating table top of the Siemens OR table. The anesthetic nurses would prefer to be positioned closer to the door to enable easier communication with their colleagues. Many state that the room should be wider but also appreciate that an OR can never be big enough. The theater nurses would like a bigger laminar airflow area with Ekroth joking that the whole ceiling should be laminar air. This would be entirely possible with the floor mounted Artis zeego and enough floor space.

All specialties are keen to see the development of a 24/7 hybrid OR servicing patients with uncontrolled bleeding such as ruptured aneurysms and trauma. For these patients, Dr. Roos states that the hybrid operating room would show its real benefit. Currently, logistics don’t allow them to man the hybrid OR out of hours but this is the ultimate goal in order to provide the gold standard of care to the population of Western Sweden at all times.

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