

Hygiene in the Hybrid OR - Special Requirements for the Imaging System

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Summary—*Asepsis must be maintained consistently for infection control in the OR. Modern ventilation systems as well as disinfection, draping, covering, and surgical techniques are critical components in this effort. In the hybrid OR, the use of an angiography system is adding complexity and may interfere with hygienic standards. Nevertheless even under these challenging circumstances hygienic standards have to be strictly followed to allow for proper infection control. This can be achieved through various procedures but most importantly requires particular attention to the planning and set-up of the ventilation system in combination with the angiography system. Using a floor-mounted angiography system, a protection level > 2 (highest level of airborne particles allowed to provide proper hygienic conditions) can be achieved in accordance with Appendix C of DIN 1946/4: 2008 with the angiography system in a working position.*

Key words—*hybrid OR, angiography system, hygiene, DIN 1946/4: 2008, protection level*

Introduction

The combination of interventional and surgical techniques (called hybrid interventions) changes and increases requirements for intraoperative imaging. Comprehensive and integrated planning of these hybrid operating rooms including medical engineering and building technology is crucial to combine the clinical and technical requirements in the working environment of surgeons, interventionalists (such as cardiologists), anesthesiologists, and technical personnel (such as MRAs or perfusionists).

A variety of rules and regulations have to be followed in order to establish proper hygienic conditions. Ventilation technology is one critical aspect. Other areas include positioning and covering the patient, preparing instruments and implants, the workflow at the operating table, in particular the position of the instrument tables. The use of medical devices and mobile as well as fixed equipment, especially lights, ceiling supply units, and the angiography system also has to be considered.

Materials and methods

Various hybrid OR installations have been studied while in operation and Best Practice analyses have been performed. Ventilation technologies have been evaluated with the imaging system in a working position. The study focused on the Artis zeego angiography system (Siemens AG Healthcare, Forchheim, Germany). Key subjects were the workflow and the technical equipment of hybrid ORs necessary to achieve room class Ia in accordance with DIN 1946/4: 2008 under working conditions. The particle count as a surrogate marker for bacterial contamination was measured in accordance with Appendix C of the German standard noted above.

Results and discussion

It is possible to successfully pass the tests required for hygiene class Ia in a working situation for hybrid ORs with a floor-mounted angiography system by using measurements of air contamination. Current norms (like DIN 1946/4: 2008) do not primarily take into account the situation in the hybrid OR. In a hybrid OR, a piece of equipment, in particular the C-arm with

a large detector, can severely interfere with the ventilation system when it is in a working position directly above the OR field.

Meaningful results of the achieved protection level can only be evaluated if measurements are obtained in user-specific setup. Therefore, test scenarios are required that are based on user-specific scenarios defined specifically for the particular installation. For the evaluation of the Artis zeego, the system was examined in a working position in a user-specific setup according to DIN 1946-4. Under these circumstances a class Ia level was achieved.

The comprehensively coordinated installation of all components is the critical prerequisite for successful qualification of an Ia OR suite. This includes the room ventilation system, installation of the angiography system, position of the OR table (particularly its position in use) and the other pendants (in particular lights and ceiling supply units). Coordination should take place early on during the general planning and project planning phases.

Workflows and ergonomics have to be optimized for the requirements of a hybrid OR. Patient positioning, accessories, and covering procedures should be adapted. For hygienic evaluations the positioning of the instrument tables as well as the process in preparing instruments and implants should be observed.

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