

Functional separation of septic and aseptic surgical procedures

Funktionelle Trennung von septischen und aseptischen OPs

Abstract

Current evidence does not favour constructional over functional separation of septic and aseptic surgical procedures in terms of overall hygiene maintenance and incidence of skin and soft tissue infections. In both laminar and turbulent flow air operating theatres, air is not a relevant source of pathogens if surface disinfection is carried out properly. Final cleaning after a septic procedure includes a thorough wipe-disinfection of all potentially contaminated near and distant surfaces, including maintaining the necessary and effective exposure time of the chosen surface disinfectant. Cleaning utensils and clothes of all team members must be disposed of before leaving the theatre, and a complete change of gowns is mandatory before re-entering the operating room area. Strict adherence to this code of behaviour will allow for efficient functional separation of clean and contaminated surgical procedures without compromising patient safety.

Keywords: operating theatre, septic surgery, clean surgery, airborne infections, laminar air flow, functional separation

Zusammenfassung

Es gibt keine epidemiologische Evidenz für den Einfluss der baulichen Trennung aseptischer/septischer OP auf die SSI-Rate. Im Ergebnis eines diesbezüglichen Risk Assessments geht sowohl bei Turbulenzarmer Verdrängungsströmung (TAV) als auch bei turbulenter Belüftung nach Schlussdesinfektion des OPs von der Raumluft keine Infektionsgefährdung für die nächste OP aus.

Die Schlussdesinfektion nach septischer OP beinhaltet die gründliche Wischdesinfektion aller potentiell kontaminierten Flächen auch im patientenfernen Umfeld mit Abwarten der deklarierten Einwirkungszeit, den Wechsel der Reinigungsutensilien und Bereichskleidung des Reinigungspersonals, die Ausschleusung des OP-Teams mit Wechsel der Bereichskleidung und erneute Einschleusung sowie den Wechsel der Bereichskleidung von Anästhesieteam und Springer.

Schlüsselwörter: OP, septische Chirurgie, aseptische Chirurgie, luftübertragene Infektionen, Laminar Air Flow, funktionelle Trennung

Background

In 1993, an interdisciplinary expert panel concluded that, from a hygienic point of view, the common claim for separating septic from aseptic operating theatres is probably unsubstantiated. Neither the degree of microbial air contamination, nor the observed incidence of wound infections is obvious if clean and contaminated surgical procedures are performed in the same theatre [1]. Whereas structural or architectural separation may be beneficial in case of a high volume of septic procedures

and capacity utilization, investments and maintenance costs for providing strictly divided septic and aseptic theatres may not be worthwhile in institutions which only occasionally treat septic patients. Septic theatres are often smaller than their aseptic counterparts which may seriously hamper workflows. At the same time, substantial human and financial resources must be expended to store materials on different surgical locations and to maintain the high hygienic standards that apply to any operating theatre, whether septic or aseptic.

Axel Kramer¹
Ojan Assadian²
Michael Wendt³
Dirk Stengel⁴
Julia Seifert⁴

1 Institute of Hygiene and Environmental Medicine, University Medicine Greifswald, Greifswald, Germany

2 Clinical Institute for Hospital Hygiene, Medical University of Vienna, Vienna, Austria

3 Department of Anesthesia and Intensive Care Medicine, University Medicine Greifswald, Greifswald, Germany

4 Department of Trauma and Orthopaedic Surgery, Clinic of Surgery, Ernst-Moritz-Arndt-University, Greifswald, Germany

In their 2000 recommendation, the German Federal Commission of Hospital Hygiene and Infection Prevention (KRINKO) did not recommend for a general separation between aseptic and septic operating theatres. However, it was noted that individual hygienic demands on equipment, environment and established processes may necessitate distinct units for surgical interventions with varying grades of microbial contamination [2].

Accordingly, the guideline of the Hospital and Practice Hygiene Working Group of the German Association of Scientific Medical Professional Bodies (AWMF) specified that septic and aseptic procedures must only be performed in the same theatre if functional and organizational measures have been implemented to ascertain patients' safety [3].

In 2011, Kramer and co-workers recommended a neutral and flexible utilization concept for surgical suites that allows for both discipline-specific and demand-driven use by different specialties and departments. This concept requires flexible positioning of the operating table, mobile equipment and media supply for varying room locations [4].

The following work further elucidates arguments why structural separation may be replaced by functional separation of septic and aseptic surgery without compromising hygiene standards and patients' safety.

Air as a source of microbial transmission

The main reservoirs for pathogens, which typically cause skin and soft tissue infections (SSI), are the patient's and the health care provider's skin and naso-pharynx, whereas airborne infections are of minor importance in this setting [5]. This may explain why current evidence fails to show a significant impact of the individual theatre type on SSI rates [5], [6].

Abrasions and natural aerosols from surgical team members are released and spread during surgery [7], [8]. The relevance of this source of contamination is confirmed by the lower incidence of SSI with impermeable clothing and drapery compared to cotton fabric [9]. Moreover, microbial air pollution increases with the number, activity and fluctuation of personnel in and out of the operating theatre. Thus, the KRINKO recommends restricting the number of persons to the necessary minimum during surgery [10].

Current evidence suggests a moderate impact of laminar air flow on infection rates, particular in knee and hip arthroplasty [6], [11], [12], [13], [14]. Concomitantly, it was demonstrated that particle counts in an ophthalmologic operating theatre with laminar flow did not increase although routine floor disinfection between procedures was stopped [15]. Refraining from routine surface disinfection, however, shortened turnaround times. However, an adequately sized laminar flow with at least 518x380 cm reduces microbial contamination 100 times 1.5 m above the floor [16].

Diligent surface disinfection after a septic procedure further reduces the risk of cross-contamination during subsequent surgery. Obvious effects were observed in a cardiologic intervention suite with turbulent mixed air flow after the introduction of additional floor disinfections in the evening after and in the morning prior to the daily schedule together with sterile hooding of monitors and image intensifiers. This simple bundle led to a re-classification of the suite from EU-Directive Class D to B, equalling a reduction in colony forming units (CFU) from 100 to only 5 cfu/m³ [17].

Altogether, airborne wound and soft tissue infections during surgery are rare events except for elective total joint arthroplasty. Regardless of the type of flow (i.e., laminar versus turbulent), air does not expose patients to an excess risk of infection if a bundle of multi-barrier protocols are observed.

Functional separation of aseptic and septic surgery

Functional separation typically means that aseptic procedures are scheduled and performed prior to septic operations. This is, however, not mandatory if key principles of hospital hygiene are respected, creating safe conditions after each surgical intervention and before the next intervention.

Laminar air flow encompassing the instrument table will cleanse the protected area from infectious particles within two minutes [18], generally allowing for re-use of the theatre five minutes after final disinfection. In case of mixed ventilation systems with common air change rates of 12 to 25 h⁻¹, the entire room volume needs to be replaced. The recovery time until 1% of the initial grade of pollution is reached is about 10 to 20 minutes, and the theatre should be used again only after an interval of 30 minutes. However, in theatres without adequate air ventilation systems, it will be difficult or even impossible to determine how long infectious particles remain in the room air. They may sediment during later operations and pose a significant risk to patients, and septic procedures should be avoided in those theatres.

The choice of an appropriate agent for surface disinfection is imperative. Quaternary ammonium compounds have only limited antimicrobial efficacy against Gram-negative bacteria *in vitro* and should be avoided, whereas oxygen-based substances have stronger antimicrobial efficacy [19].

The effective duration of the individual disinfectant must be pursued, and the planned interval until re-use of the theatre must fit in with the indicated minimum exposure time.

In addition to standard interim disinfection between two aseptic procedures, final disinfection after a septic surgical intervention comprises the following steps:

- Thorough wipe-disinfection of all potentially contaminated surfaces near and distant in the patient's envir-

onment, including those without obvious contamination, allowing for the indicated exposure time of the agent.

- The theatre has to be flagged as “septic” until the disinfection procedure is completed.
- Thorough change of all cleaning utensils and cleaners’ clothes.
- All team members (i.e., nurses, surgeons, anaesthesiologists) must change clothes and shoes inside the OR unit, leave the area and only re-enter after re-coating.

Key elements of functional separation must also apply to aseptic surgery if the patient carries or is infected with multi-resistant bacteria.

Implementing evidence-based guidelines for peri-operative infection prevention and multi-barrier strategies can prevent SSI in clean and contaminated surgery [20], but adherence to these standards must be regularly monitored with the use of checklists [21].

Notes

Conflicts of interest

The authors declare that they have no competing interests.

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Corresponding author:

Prof. Dr. med. Axel Kramer
Institute of Hygiene and Environmental Medicine,
University Medicine Greifswald, Walther-Rathenau-Str.
49a, 17489 Greifswald, Germany, Phone:
+49-3834-515542, Fax: +49-3834-515542
kramer@uni-greifswald.de

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