Recommendations for the prevention of surgical site infections during postoperative nursing care in surgery departments

Zalecenia profilaktyki zakażeń miejsca operowanego w okresie pooperacyjnej opieki pielęgniarskiej na oddziałach zabiegowych

Authors:

Maria T. Szewczyk[1,2,3], Paulina Mościcka[4,5,6], Justyna Cwajda-Białasik[4,5,7], Arkadiusz Jawień[8,9,10], Eugenia Gospodarek[11,12,13], Aleksander Deptuła[11,14,15], Maria Kózka[16,17,18], Jacek Szopiński[19,20], Agnieszka Mikucka[11,21,22], Katarzyna Ciezniakowska[5,23], Aleksandra Popow[4,24], Elżbieta Kozłowska[4], Bartosz Fórmankiewicz[5], Małgorzata Rucińska[25]

Expert Team:

Maria T. Szewczyk[1,2,3], Arkadiusz Jawień[8,9,10], Eugenia Gospodarek[11,12,13], Paulina Mościcka[4,5,6], Justyna Cwajda-Białasik[4,5,7], Maria Kózka[16,17,18], Aleksander Deptuła[11,14,15], Jacek Szopiński[19,20], Agnieszka Mikucka[11,21,22], Katarzyna Ciezniakowska[5,23], Małgorzata Rucińska[25], Aleksandra Popow[4,24] Elżbieta Hancke[5], Regina Sierżantowicz[26,27], Tomasz Urbanek [28], Grzegorz Wallner[29], Piotr Andziak[30], Jacek Klawe[31], Wojciech Zegarski[32], Anna Spannbauer[33], Mariola Sznapka[34], Lucyna Kiełbasa[35], Włodzimierz Majewski[36], Bożena Gorzkowicz[37], Teresa Socha[38], Małgorzata Hejmo[38,39], Małgorzata Szczepaniak[40], Anna Szczerbik[39]

[1]National Consultant for Surgical and Operative Nursing
[2]Head of the Chair of Surgical Nursing and Department of Surgical Nursing and Chronic Wound Treatment, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń
[3]Vice-President of the Polish Society of Angiology Nursing, member of the Polish Nurses' Association and many other scientific associations
[4]Department of Surgical Nursing and Chronic Wound Treatment, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń
[5]Chair and Department of Vascular Surgery and Angiology, A. Jurasz University Hospital no. 1
[6]Secretary of the Polish Society of Angiology Nursing
[7]President of Polish Society of Angiology Nursing
[8]Head of the Chair and Department of Vascular Surgery and Angiology, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń, A. Jurasz University Hospital no. 1
[9]President of the European Society for Vascular Surgery
[10]Member of the Executive of the European Wound Management Association and many Polish, European and American scientific associations
[11]Chair and Department of Microbiology, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń, A. Jurasz University Hospital no. 1 in Bydgoszcz
[12]President of the Polish Society of Microbiologists and the "Microbiology Development" Association, Deputy Dean of the Faculty of Pharmacy, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń
[13]Member of the Microbiology Committee of the Polish Academy of Sciences, Polish Society of Hospital Infections, Society of Clinical Microbiology
[14]Coordinator of Point Prevalence Survey of Healthcare Associated Infections and Antibiotic Use (PPS HAI & AU) in Poland, National Programme of Antibiotic Protection
[15]Member of HAI-Net Coordinating Committee, European Centre for Disease Prevention and Control, Stockholm
[16]National Consultant for Nursing
[17]Head of Department of Clinical Nursing Institute of Nursing and Midwifery, Medical College Jagiellonian University in Cracow
[18]Deputy Dean of the Faculty of Health Sciences, Jagiellonian University Medical College in Cracow
[19]Chair of General Surgery and Transplantology – Department of Liver Surgery and General Surgery, Outpatient Clinic for Parenteral and Enteral Nutrition – Chair of Anaesthesiology and Intensive Therapy, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń, A. Jurasz University Hospital no. 1 in Bydgoszcz
[20]Executive Director of the Polish Hernia Club, member of the Polish Society for Parenteral, Enteral Nutrition and Metabolism, member of the Section of Surgical Infections of the Association of Polish Surgeons

[21]Scientific Secretary of the Polish Society of Microbiologists
[22]Member of the "Microbiology Development" Association, Polish Society of Hospital Infections, Society of Clinical Microbiology
[23]Provincial Consultant for Surgical and Operative Nursing
[24]Provincial Consultant for Nursing
[25]Team for the Control of Hospital Infections, A. Jurasz University Hospital no. 1, L. Rydygier *Collegium Medicum*, Nicolaus Copernicus University in Toruń
[26]Department of Surgical Nursing, Medical University in Białystok
[27]Provincial Consultant for Surgical and Operative Nursing
[28]President of Polish Society of Phlebology, member of many other scientific associations
[29]President of Association of Polish Surgeons, Provincial Consultant for Surgery, 2nd Department of General, Gastrointestinal and Surgical Oncology of the Alimentary Tract, Independent Public Teaching Hospital No. 1 in Lublin
[30]National Consultant for Vascular Surgery, Head of Department of General and Vascular Surgery in CSK MSW in Warsaw, Chair and Department of Vascular Surgery and Angiology, Medical University of Warsaw, member of many scientific associations
[31]Provincial Consultant for Public Health, Prorector of Faculty of Health Sciences, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń, Head of Chair and Department of Hygiene and Epidemiology, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń
[32]Consultant for Oncological Surgery, Head of Chair of Oncological Surgery, Faculty of Health Sciences, L. Rydygier *Collegium Medicum* in Bydgoszcz, Nicolaus Copernicus University in Toruń, member of many scientific associations
[33]Associate Professor in Department of Experimental and Clinical Surgery, Faculty of Health Sciences, Jagiellonian University Medical College in Cracow, Division of Anesthesiology and Intensive Care, St. John Grande Hospital of the Merciful Brothers' order in Cracow
[34]Phd student, Medical University of Silesia in Katowice, Charge Nurse in Division of General and Vascular Surgery and Angiology, Independent Public Clinical Hospital No. 7, Medical University of Silesia, Professor Leszek Giec Upper Silesian Medical Centre
[35]Lecturer of Chair of Nursing, Faculty of Medical Sciences, University of Warmia and Mazury in Olsztyn, Head of Przedsiębiorstwo – Ambulatorium Miejskie, pełnomocnik ds. systemu zarządzania jakością, The Nicolaus Copernicus Municipal Polyclinical Hospital in Olsztyn
[36]Head of Department of Surgical and Emergency Nursing, Faculty of Health Sciences, Pomeranian Medical University in Szczecin, member of many other scientific associations
[37]Department of Surgical and Emergency Nursing, Faculty of Health Sciences, Pomeranian Medical University in Szczecin, member of many other scientific associations
[38]Member of Polish Society of Angiology Nursing, Provincial Division of Vascular Surgery and Angiology, St. John Grande Hospital of the Merciful Brothers' order in Cracow
[39]Clinical Division of Internal Diseases, St. John Grande Hospital of the Merciful Brothers' order in Cracow
[40]Provincial Division of Vascular Surgery and Angiology, St. John Grande Hospital of the Merciful Brothers' order in Cracow

Abstract

Until now, Poland did not have uniform national guidelines for the prevention of surgical site infections (SSI) in the area of perioperative nursing care. Key criteria for effective SSI prevention are included in the current CDC recommendations.

The aim of this document is to address activities undertaken by surgical nurses with respect to SSI prevention on the basis of up-to-date and reliable research results.

The document contains 15 recommendations for postoperative prevention of SSI and complements the study focusing on the preoperative period.

Integration of the recommendations into daily practice is expected to improve the quality of nursing care provided to patients, increase patient satisfaction with medical care and reduce costs.

Key words: postoperative care, SSI prevention.

Introduction

Recent years have seen an alarming increase in bacterial resistance to antibiotics. The observed tendency restricts the possibility of effective treatment of hospital-acquired infections, including surgical site infections (SSI), and promotes the spreading of hospital strains. Considering the circumstances, rational antibiotic use is advised on the one hand, and preventing situations which require antibiotic therapy is recommended on the other. The most effective and at the same time the cheapest way of fighting antibiotic resistance is preventing and controlling infectious diseases and hospital-acquired infections, SSI included. The current recommendations issued by the Centre for Disease Control and Prevention (CDS) place an emphasis on the importance of several components in SSI prevention. They include optimum preparation of patients for surgery, operative technique, compliance of medical personnel with principles of the aseptic technique, and comprehensive postoperative care [1-3].

Recommendation 1

The patient should be transported from the operating suite in a bed assigned to that patient in the hospital unit and provided with clean bedding.

Rationale

The postoperative period begins when the patient is taken over from the operating suite and transferred to the intensive care unit or surgical unit [4]. The bed assigned to the patient in the hospital unit is believed to be the safest and the most hygienic means of transporting the patient between the unit and the operating suite. Patient trolleys or transfer stretchers require disinfection after each use. Transporting several patients using the same "contaminated" trolley is prohibited according to the rules of prevention of hospital-acquired infections. Prior to the operative procedure, the patient should be transported in a clean bed to the operating suite air-lock, where the patient should be moved e.g. to a mobile operating table or a clean bed, and transferred to the top of the operating table in compliance with operating suite standards. For planned procedures, wheeling the bed to the operating room directly from the hospital unit is prohibited. There is a set of patient transfer rules that must be followed in the operating suite [5, 6].

Practical implications

The patient is transported back from the operating suite to the unit in a clean bed and in compliance with the applicable procedure.

Recommendation 2

Hypothermia should be prevented both during the transport of the patient and in the immediate postoperative period.

Rationale

A decrease in body temperature during and after operative procedures is linked to a delay in wound healing [7, 8]. Hypothermia leads to tissue hypoxia and elevates the risk of SSI [5, 6]. The incidence of SSI at the body temperature of 34°C was 19%, compared to 6% in patients with normal body temperature (36.6°C). The authors state that perioperative warming applied e.g. in mastectomy patients was shown to have a similar efficacy in SSI prevention as antibiotic prophylaxis [6].

The highest drop in body temperature is usually observed for approximately one hour after surgery. During that time, heat loss should be prevented e.g. by covering the patient with an additional blanket, warming up infusion fluids to 37°C and ensuring optimum microclimate in the patient room, including the ambient temperature of approx. 21°C [4, 9]. If chills occur, the administration of oxygen therapy should be considered [4, 5, 10].

Practical implications

The patient is transported from the operating suite to the unit in a heated bed and covered with an additional blanket. In the unit, the attending nurse monitors the patient's body temperature and behaviour, checks skin colour and warmth, and measures pulse and blood pressure. The nurse also makes sure that the humidity in the patient room is 60%, and the ambient temperature is within the range of 21°C-24°C. If the patient's body temperature is 35°C, the nurse applies forced air heating, electric warming pads or heating blankets, and dresses the patient in cotton socks. Infusion fluids should be warmed to 37°C, and irrigation fluids to 38-40°C, during their administration.

Recommendation 3

Optimal glycaemic control should be ensured in all patients.

Rationale

Diabetes has been shown to cause a two- or even three-fold increase in the risk of SSI and infection-related complications. The likelihood rises together with an increase in hyperglycaemia in the perioperative period. According to CDC guidelines, the level of post-meal glycaemia before a procedure should be maintained at < 200 mg/dl [2]. The American Diabetes Association (ADA) proposes the following optimum parameters before a procedure: glycosylated haemoglobin HbA_{1c} < 7%, average pre-meal glucose level of 90-130 mg/dl, and post-meal glucose level < 180 mg/dl [11]. In order to achieve appropriate metabolic control and optimize biochemical parameters, the Polish Diabetes Association recommends the admission of diabetic patients ca. 2-3 days prior to the planned operative procedure [2, 12].

A mild postoperative increase in blood glucose level above the normal physiological limit is an element of the body's natural metabolic response to injury, and occurs independently of coexisting diabetes. This is followed by the release of proinflammatory cytokines and an increased susceptibility to infection [10]. Effective control and maintenance of appropriate blood glucose levels both pre- and postoperatively reduces the risk of SSI. According to recommendations issued by the Polish Diabetes Association, the optimum glycaemia range in diabetic patients until normal nutrition is resumed is 100-180 mg/dl [12]. Maintaining similar glycaemia values is also recommended in non-diabetic patients. For example, the Portland Protocol recommends 100-150 mg/dl as the optimum glycaemia range after cardiac surgery [13].

Practical implications

The attending nurse constantly monitors and measures the patient's blood glucose level to ensure early detection of symptoms of hyper- and hypoglycaemia. In the event of metabolic disorders, the nurse cooperates with the medical team in diagnostic and therapeutic interventions.

Recommendation 4

Postoperative wounds closed by primary sutures should be protected with a sterile dressing for a minimum of 24-48 hours.

Rationale

Clean postoperative wounds are typically closed using surgical thread, staples and occasionally tissue adhesive, and then protected with a sterile dressing [14, 15]. Dry dressings are the most commonly used type. They are composed of a gauze or non-woven fabric pad, or a compress with an absorbent core, and are secured to the skin using a standard surgical adhesive bandage (e.g. made of a non-woven fabric). Postoperative wound dressing is applied primarily to provide the wound with a protective barrier against contamination, infection, injury, etc., and to absorb exudate and secretions. Wound dressing performs the functions listed above at least until epidermal continuity is restored, i.e. for ca. 48 hours postoperatively in the case of wounds healing by primary intention [15, 16]. The epidermis closes the entry portal for potential infections, and protects the wound from external factors including contaminants but also air (e.g. exposure during dressing changes), water (e.g. exposure during bathing) and others [17]. In practice, due to various reasons, wounds are covered for a longer period, e.g. until the removal of sutures.

According to recommendations issued by NICE (*National Institute for Health and Care Excellence*) [10] and CDC [2,18], wounds which heal without any complications do not require longer use of dressings. The study [19] comparing the effects of covering postoperative wounds with gauze dressings until postoperative day 7 and until postoperative day 2 did not demonstrate statistically significant differences in the incidence of infectious complications. Gauze dressings in both studied groups were changed once daily. The evaluation comprised exclusively clean surgical wounds closed by

primary sutures and dressed with sterile gauze. A systematic review of literature [15] showed that both early (within 48 hours after surgery) and late (beyond 48 hours after surgery) uncovering of the wound had no significant effect on the risk of surgical site infection. A 30-day follow-up period failed to identify significant differences between the early and delayed dressing removal groups in the incidence of superficial surgical site infections, separation of wound margins and dehiscence, and other local complications.

However, it is emphasized that early removal of gauze dressing is a cost-efficient approach, as it cuts costs of materials, reduces total nursing time and shortens the period of hospitalization [15, 19]. The authors of the study [19] also claim that early removal of wound dressing encourages patients to perform hygienic care and accelerates their postoperative activation. Infected wounds and wounds at a high risk of infection should be managed in accordance with recommendations developed by the Polish Wound Management Association [17].

Practical implications

Wounds closed by primary sutures should be protected by a sterile dressing for approx. 48 hours after the operative procedure. The decision to remove a wound dressing should be made on a case-by-case basis, taking into account clinical and economic factors, and patient comfort.

A longer period of wound dressing can be considered in the case of wounds healing by secondary intention, complicated, infected and/or at a risk of infection. It may also be necessary to leave the wound dressing for longer periods due to the use of topical medicines or specialist and antibacterial dressing types.

Recommendation 5

Postoperative wound dressings should be changed in a facility with a microbiologically safe environment.

Rationale

Facilities with less than 10 bacterial cells per 1 m^3 of air are considered safe to the patient [20]. Medical areas can be divided into four sanitary zones. Patient rooms are classified as zone II ("general medical cleanliness"), whereas surgery rooms and wound dressing rooms are considered zone III ("variable cleanliness") areas. The zones demonstrate varying levels of pathogenic contamination and require different sanitary procedures. The primary sanitary procedure in zone II is washing, and in zone III – washing combined with disinfection. In order to contain the spreading of pathogenic microorganisms, it is crucial to use effective washing and disinfecting agents, and ensure strict adherence to the sanitary regime. Changing wound dressings in the surgery room makes it possible to eliminate potential sources of wound infection including patient environment in the patient room, other patients and their environment, and contaminated air. In addition, it shuts down routes of infection by performing disinfection of facilities between wound dressing changes in consecutive patients. Minimizing the risk of infection requires the separation of clean and septic procedures [21-23].

Practical implications

Changes of wound dressing should be performed in aseptic conditions.

Recommendation 6

Postoperative wound management with specialist surgical dressings should be considered in patients at an increased risk of SSI.

Rationale

A review of five randomized controlled clinical trials conducted by NICE in 2008 [24] did not reveal statistically significant correlations between the risk of SSI and the type of dressing. Similarly, review studies including Cochrane [25] in 2011, and the review performed in 2012 [26], failed to provide evidence for the superiority of any particular simple dressings in SSI prevention. It must be noted, however, that the results of individual studies were interpreted cautiously due to a small number of patients in the study groups, and the risk of statistical error. A limitation in the generalization of conclusions was the fact that they referred to the analysis of wounds demonstrating varying degrees of microbiological cleanliness, the application of different regimens of antibiotic prophylaxis and other factors [25, 26]. The authors of the study [26] stress that only a few studies showed the superiority of selected specialist dressings (e.g. PU membranes, hydrocolloid dressings) over standard gauze compresses. One study observed significant differences in the incidence of SSI involving superficial tissues in wounds dressed with PU and gas dressings [27]. Significant differences were observed rather in the effect on the risk of non-infectious complications such as atraumaticity, better tolerance by the patient and pain relief [26]. No differences were found with respect to the incidence of deep and organ infections.

Recent years have seen the introduction of new-generation **specialist postoperative dressings** into surgical practice [11, 28, 29]. They differ from the first specialist dressings (e.g. hydrocolloids, PU membranes) in their design which combines the characteristics of several different material layers. The layer which is in direct contact with the wound has absorbent properties, and the outer layer has occlusive properties, and secures the dressing. Specialist surgical dressings ensure that wounds heal in the optimal moist environment, without the formation of a scab, which has so far been indicated mainly in the healing of chronic wounds. Several prospective randomized clinical trials have shown their favourable effect on the process of postoperative wound healing [11, 28-30]. The study [11], which was conducted in a group of over 400 patients with clean surgical wounds after planned operative procedures, compared a specialist surgical dressing made of a non-permeable PU membrane and an absorbent layer with a traditional gauze compress. The risk of SSI was found to be significantly lower in wounds dressed with specialist dressings. The group using specialist wound dressings had a significantly lower incidence of superficial wound infections (1.4% *vs* 6.6%), blistering around the wound (2.3% *vs* 8.7%) and local erythema (2.8% *vs* 12.2%) than the group in which wounds were managed with gauze dressings. Another study [28, 29] comprised a total of 428 patients after orthopaedic procedures (hip and knee arthoplasty). A comparison of two methods of postoperative wound dressing demonstrated the superiority of the specialist dressing (based on the *Jubilee* method) over the standard gauze-based dressing.

An example of specialist surgical dressings are materials based on the *Jubilee* method which combine the *Hydrofiber®* technology and a hydrocolloid into a single dressing. The central part is an absorbent hydrofibre core reinforced with nylon, directly covering the surgical incision site. The hydrocolloid layer secures the dressing in place, and the outer membrane is an effective barrier preventing pathogen entry. Watertight properties allow the bathing and hydrotherapy of patients in the immediate postoperative period. In addition, the dressing facilitates effective patient rehabilitation and activation. Being elastic and adjustable to the wound (e.g. on an extremity, in a joint area), it ensures unimpaired mobility of patients. Specialist surgical dressings are designed for surgical wounds managed by primary closure, and in patients at a risk of SSI [28-30].

Practical implications

The preferred method of managing postoperative wounds in patients with multiple local and systemic risk factors for SSI are specialist surgical dressings.

Recommendation 7

Aseptic non-touch technique is recommended for changing postoperative wound dressings.

Rationale

Aseptic non-touch technique (ANTT) is recommended during changes of wound dressings and when handling drain entry sites in order to prevent microorganisms on the personnel's hands, surfaces and instruments from being introduced into the wound [10]. ANTT is currently the standard method in the majority of surgical procedures associated with a risk of infection, e.g. catheterization and vascular access procedures, or postoperative wound care. ANTT is based on the identification of "key parts and key sites", i.e. elements which must be protected from touching and microbiological contamination during surgical activities. Key parts refer to pieces of equipment (instruments, dressing kits) which come into direct contact with the patient (grasping ends of forceps, scalpel blade, contact layer of dressings), whereas key sites are susceptible areas on the patient's body, e.g. the postoperative wound. In practice, ANTT also comprises hygienic washing and disinfection of hands, preparation of a sterile area for medical equipment and materials, and compliance with the appropriate sequence of activities during wound dressing changes [31]. Consecutive stages involved in ANTT-based change of dressing in clean postoperative wounds in the surgery room are described in Annex 1.

The aseptic non-touch technique is also mandatory during every surgical procedure performed within the vascular access site, e.g. cannulation of veins (peripheral, central) or arteries, connection of transfusion sets, administration of medicines, changes of wound dressing and cannula removal [32, 33]. Critical parts that must be considered while applying ANTT include line/cannula entry after disconnecting the luer-lock or the transfusion set, syringe tip and entry of the transfusion set connected to the line. Principles of care and prevention of septic complications related to vascular access are listed in the table included in Annex 2. All activities connected with the monitoring, placement, replacement and maintenance of vascular lines must always be entered in appropriate medical records.

Practical implications

Familiarity with the aseptic non-touch technique (ANTT) and its incorporation in the form of a standard followed e.g. during changes of dressing, vein cannulation and maintenance of vascular access sites, can significantly lower the incidence of healthcare-associated infections, SSI included. A necessary prerequisite for the effective implementation of ANTT requires a periodic procedure to verify correct application (auditing).

Following ANTT rules during changes of postoperative wound dressings can significantly reduce the incidence of SSI. The charge nurse or coordinating nurse should periodically check ANTT compliance.

Recommendation 8

Primarily healing wounds should be physically cleaned with sterile saline, without routine use of antibacterial agents.

Rationale

A sufficient procedure for managing wounds without signs of infection is physical cleaning with an aqueous solution, e.g. of an antimicrobial cleansing agent ("lavaseptic") without medicinal substances [10, 34]. Both NICE and the Polish Wound Management Association (PTLR) recommend using sterile saline [10,17,34], Ringer's solution or multi-electrolyte fluid [34] for cleaning primarily healing wounds after operative procedures (usually for 48 hours). Their activity is sufficient for the mechanical removal of pathogens, excess blood and exudate, as well as necrotic tissues, from the wound and its surrounding area. Maintaining the wound in a hygienic condition also has a favourable effect on the patient's general well-being [10].

Products with a topical antimicrobial activity include lavaseptics (e.g. aqueous solution of octenidine dihydrochloride) and antiseptics. Lavaseptics work by cleaning the wound and physically eradicating as many

pathogens as possible. In contrast, antiseptics are applied to eradicate and inhabit the growth of pathogens colonizing or infecting the wound [34]. Using the products listed above is beneficial in patients at a risk of SSI, with wounds that are contaminated and at a risk of infection [34-36]. The application of antimicrobial products in SSI treatment should conform to the current recommendations, e.g. issued by the Polish Wound Management Association [34].

Practical implications

A sufficient procedure for cleaning primarily healing wounds involves sterile saline, Ringer's solution or multi-electrolyte fluid. Products containing an active antimicrobial agent are used for cleaning wounds which are infected or at a risk of infection.

Recommendation 9

Microbiological evaluation is advisable in patients with symptoms of infection or inhibition of the process of wound healing. Samples for microbiological tests should be collected after thorough cleaning of the wound using two swab sticks.

Rationale

Microbiological testing should be performed only if signs of wound infection are identified or the process of wound healing is delayed, and in particular:

- when antibiotic therapy is necessary,
- in more severe infections,
- in cases of suspected infection with a drug-resistant microorganism (patients with a history of multiple hospitalizations or treatment in hospital units at a high risk of infection with multidrug resistant microorganisms),
- in patients who are allergic to first-line antibiotics recommended in the empiric therapy of SSI [37].

Classic microbiological methods (direct slide, culture, antibiogram) are of key importance in deciding on the introduction of antibiotic therapy, but are only useful if the physician and microbiologist cooperate and properly address the problem at hand [38]. Irrespective of the type of microbiological test (qualitative test – usually a swab, quantitative – biopsy specimen), the wound should be cleaned before the collection of material for testing, and the collected sample should be properly protected. If a sample cannot be delivered to a microbiological laboratory promptly after collection, it should be placed on a transport medium [37, 39, 40]. Methods applied in the microbiological diagnostics of SSI include [39, 41-44]:

1) Microscopic examination – Gram-stained direct slide,
   - time until result: 10-30 minutes from the start of slide preparation,
     – qualitative test: type of material: wound swab, pus, wound aspirate (fluid), tissue fragment,
     – correlates with culture results if the microbial count is minimum 10^5 cfu/g of tissue (cfu – colony-forming units) or mm^3 of pus; useful especially in infections of clean mono-aetiological wounds; sensitivity: 38%, specificity: 90%.
2) Culture:
   - time until result: 24-48 hours from the start of culture, 2-5 days for cultures of anaerobic bacteria,
   - qualitative/semi-quantitative test:
     – type of material: swab from the margins and centre of the wound, pus, tissue fragment, blood (if generalized infection is suspected),
     – suitable when there are signs of wound infection and/or inhibition of wound healing; the method is simple, inexpensive and non-invasive; allows

Table 1. Stages of wound infection [38]

Progression of the clinical problem →					
Contamination	Colonization	Critical colonization (no signs of infection and/or inflammation)	Localized infection	Spread of infection	Generalized infection
Vigilance required			Intervention required		

the detection of potential pathogens and evaluation of microbial diversity (index of wound bacterial load),
  – positive blood culture is indicative of infection spread, particularly if the same pathogen species is isolated from the wound culture,
- quantitative test (cfu/g of tissue or mm^3 of pus):
  – type of material: wound biopsy specimen,
  – allows the differentiation between contamination and colonization/infection; the method is invasive, potentially traumatic to the patient, and time-consuming.

Practical implications

The nurse collects appropriate material for microbiological tests to isolate the aetiological factor underlying the infection and determine microbial sensitivity to antibiotics. The methods of material collection, preservation and transport must be arranged with the microbiological laboratory. A close cooperation between microbiologists and physicians makes it possible to correctly interpret microbiological findings, ensuring rapid and effective administration of targeted antibiotic therapy.

Recommendation 10

Post-operative patients should be encouraged to take a shower or whole-body bath early after surgery.

Rationale

Patients may be reluctant to take a whole-body bath, as they are concerned about the irritant effect of water or soap on the skin, and maceration of the wound area. Bearing in mind the risk of local complications and healing disorders, it is usually recommended to keep the wound completely dry and refrain from taking a whole-body bath until the second postoperative day or later [16]. In extreme cases, it may be advisable to avoid taking a bath or getting the wound wet for several (up to a dozen) days until the removal of wound dressing or sutures. Numerous studies have found that an early postoperative shower does not increase the risk of wound infection and does not interfere with the healing process [16, 17, 45].

A study performed in a group of patients after a planned operative procedure within the foot and ankle who were advised to have a daily shower during the first postoperative check-up found no significant effect of showering on the frequency and severity of infectious complications. The patients showered in tap water and used regular soap, but avoided intentional wetting and immersion of the operated foot in water. The first exposure of the wound to water took place on average four days after the operation [45]. Similar results were obtained in a group of diabetic patients [46].

A review of studies [15, 13] demonstrates that **patients can take a shower or a whole-body bath on their own as early as 12 hours after the operative procedure or earlier**, as long as their general well-being and overall physical and mental condition allow. Exposing the wound, even during the first two postoperative days, by removing the dressing and wetting the wound during hygienic procedures does not contribute to an increase in SSI risk [16, 17, 45].

Patients in the immediate postoperative period should follow several principles when taking a shower or a bath:

- Remove the gauze dressing from the wound directly before taking a bath; only dressings made of water-resistant materials (e.g. specialist surgical dressings) can be left on the wound.
- The optimum temperature of shower/bath water is approx. 37 °C. Adding substances with proven antibacterial and antifungal effectiveness (e.g. octenidine hydrochloride, and other antiseptics with scientifically proven biocidal effectiveness) is recommended.
- Use gentle washing agents: liquid soaps/body wash gels with an acidic pH or baby cosmetics. Do not use washing agents containing cosmetic colourants, preservatives, aromatic substances or hard potassium soap due to high pH and skin-drying properties.
- Wash the wound area with a single-use washing mitt (use a different one than the one used for body washing) or with a hand. Multiple use sponges are contraindicated, as they are reservoirs of pathogens, exfoliated epidermal cells, dust and contaminants.
- Avoid intentional wetting of the wound and other forms of prolonged body immersion in water. If the patient does not use water-resistant wound dressings, taking a bath, swimming in a pool or hydrotherapy should not be used until the wound is healed.
- Dry the wound area gently and thoroughly using a disposable towel or a regular towel dedicated only for this purpose.

Protect the wound with a sterile dressing.

Practical implications

Hygienic activities performed by the patient in the early postoperative period prevent the accumulation of perspiration and dirt on the patient's body and in the wound area. A shower or a bath in running water gives many patients a greater sense of comfort and cleanliness than bedside washing. Also, early activation of the patient reduces the risk of developing other postoperative complications and improves the patient's independence in self-care.

Recommendation 11

Patient care requires compliance with the rules of hand hygiene.

Rationale

Adherence to good hand hygiene by medical personnel is one of the most important practices preventing the spread of hospital-acquired infections [47]. The WHO Guidelines on Hand Hygiene in Health Care [48] state that hand contamination by medical personnel is the most common route of transmission of hospital-acquired infections. Many clinical studies have demonstrated that the hands of medical personnel play an important role in the transmission of pathogens between patients or between the environment of the hospital unit and the patient [23, 49]. Compliance with the procedure of hygienic washing and disinfection of hands by members of medical personnel is one of their main duties in patient care. It is also one of patients' fundamental rights.

Medical personnel is obliged to follow the procedure of hygienic hand washing according to the PN-EN 1499 standard, and the procedure of hygienic hand disinfection by rubbing a disinfecting agent in conformity with the PN-EN 1500 standard. The method of hand washing and disinfection developed by G.A.J. Ayliff applies to all medical professionals [47].

Hand washing and disinfection should not be performed concurrently. Hand disinfection with alcohol-based products, preceded each time by hand washing, increases the risk of skin irritations, and improper hand drying prior to disinfection may decrease the effectiveness of the antiseptic agent [50, 51]. WHO guidelines for hand hygiene [49, 52]:

I. Hand washing indications:
   1. when visibly dirty,
   2. if a patient has been diagnosed with an infection caused by *Clostridium difficile* because an alcohol-based agent is not effective in the eradication of spores.

II. Hand disinfection indications:
   1. before contact with the patient,
   2. before a clean/aseptic procedure (e.g. change of dressing on a postoperative wound),
   3. after exposure to body fluids/infected material,
   4. after contact with the patient,
   5. after contact with the vicinity of the patient.

When adopting its *Guidelines on Hand Hygiene in Health Care. First Global Patient Safety Challenge „Clean Care is Safer Care"*) [48], WHO stressed that **hand hygiene is the basic factor ensuring the safe care of patients**.

Practical implications

1. A hygienic hand washing station is equipped with a no-touch dispenser (elbow- or photocell-activated) for soap and disinfectant, a paper-towel dispenser and a container for used towels.
2. No-touch washbasin fittings in the surgery room.
3. Suitable preparation of the hands of medical personnel for work: short natural nails, no nail polish, no hand jewellery, short-sleeved clothing, irritation- and injury-free skin, etc.
4. Hand disinfectant available in every point of care (surgery room, patient room, surgical cart, etc.).
5. The hand and disinfection agent must be approved by the personnel.
6. To reduce the risk of skin irritation caused by frequent hand decontamination, the personnel should regularly use skin care preparations.

Recommendation 12

Hygienic washing or disinfection of hands should preferably be performed in the so-called point of care, i.e. the location in which a procedure is carried out or care delivery takes place.

Rationale

Caring for patients with postoperative wounds should involve a number of aspects related to hand hygiene which are recommended by WHO and CDC [18, 47, 48, 53]. Experts point out the importance of five steps to hand hygiene in healthcare centres. They note that washing hands before and after a procedure (e.g. change of wound dressing) is not a sufficient procedure, and it is necessary to adhere to all key moments in maintaining good hand hygiene [48]. Hygienic washing and disinfection of hands should be performed in the so-called point of care, i.e. location in which a procedure is carried out or a care delivery takes place, immediately after its completion [53, 47, 48]. No key moments referred to above should be ignored or adjourned, even after contact with seemingly "harmless" and non-contaminated materials, e.g. bed linen, patient gowns, bedside furniture or equipment in the patient room [48]. Hospital pathogen strains are found not only in infected and draining wounds, but they also frequently colonize areas of normal, intact patient skin. Natural exfoliation of the epidermis containing live microorganisms causes contamination of all objects in the immediate vicinity of patients. The hands and the gloves of medical personnel can be contaminated e.g. with Gram-negative rods, Gram-positive bacteria including *Staphylococcus aureus*, enterococci or *Clostridium difficile* bacteria even after performing "clean procedures" or simply touching the skin of hospitalized patients [48, 54].

Practical implications

Hand disinfection should be performed next to the patient in the point of care, i.e. at a distance not exceeding 1.5 m. After patient contact, pathogens are able to survive on the hands of the personnel for 2-60 minutes. The lack of disinfection after a procedure and/or between consecutive patients results in the transmission of pathogens. A convenient solution can be portable dispensers with a hand disinfectant.

Recommendation 13

The standard procedure of hygienic hand washing should be performed according to the PN-EN 1499, and the standard procedure of hygienic hand disinfection by rubbing a disinfectant based on the PN-EN 1500 standard.

Rationale

The conditions for effective hand hygiene corroborated by results of scientific research are set out in recommendations issued by CDC and WHO (Annex no. 4) [47, 48]. In order to improve the quality of patient care and safety, all medical sector professionals are encouraged to implement the programme developed by WHO [48], consistently adhere to all recommendations, ensure ongoing monitoring and supervision of effective hand hygiene, and hold regular trainings on the topic, both for the medical profession and for the society at large. It is also important to draw attention to the Global Handwashing Day, a global social educational initiative founded by UNICEF which has been celebrated annually on 15 October for a decade.

Practical implications

The recommendation prepared by WHO for the hand hygiene programme guarantees and supports the implementation process in all healthcare centres.

Recommendation 14

Patients should be monitored with a focus on early identification of SSI throughout the entire period of hospitalization.

Rationale

Elements of strategic activities aimed at reducing the risk of surgical site infections include monitoring and recording of infections. Ongoing monitoring provides actual information about the incidence of SSI and dominant aetiological factors, and makes it possible to control the epidemiological condition of the hospital and its units [55]. An increase in the duration of active monitoring has been shown to be correlated with a decreasing tendency for SSI indices. In practice, the most effective solution, demonstrating a sensitivity level of up to 95%, is the Active Monitoring System which was developed and first implemented by the Polish Society of Hospital Infections in 2001. In addition to other components, the System currently comprises detection, qualification and recording of hospital-acquired infections performed e.g. by an epidemiological nurse. Collected data are periodically examined by the Infection Control Team [3, 55, 56]. They include, among others, systematic reviews of medical documentation (fever charts, medical order sheets, results of microbiological tests). An important element of monitoring is daily inspection and direct observation of the wound. Particularly close attention should be paid to the most subtle changes occurring at the stage of critical colonization which precedes a symptomatic infection. Critical colonization is defined by the Expert Team of the Polish Wound Management Association (PTLR) as a condition linked to the growth of a large number of bacteria delaying the process of wound healing, occasionally causing severe pain but not yet involving strong immune activation of the body [34]. Detecting the first symptoms of infection requires close monitoring of the progression of the healing process by a nurse. SSI usually manifest themselves as local redness, escalating pain, swelling, local increase in tissue temperature and presence of a purulent exudate [18, 34, 55, 57]. In some patients, local symptoms are very minor, but generalized symptoms of infection (e.g. increase in inflammatory markers, fever, septic state) escalate very rapidly [58]. Also, nursing personnel may expect an atypical clinical course and mild symptoms of SSI in patients with impaired immunity including diabetics, obese and elderly patients [34, 57].

Practical implications

The dressing nurse and attending nurse are responsible for the daily monitoring of patients with postoperative wounds, and for documenting results of monitoring and measurements. Early detection of local infections allows prompt administration of treatment.

Recommendation 15

Education of patients in self-care and self-observation, as well as continuity of care with respect to SSI identification, should be ensured also after the hospitalization period.

Rationale

A SSI-related increase in body temperature or fever usually does not occur until 3-4 days after an operative procedure or even later [34, 55, 57]. The same also applies to other symptoms of deep and organ infections, and to symptoms of implant-related infections. CDC guidelines require wounds of this type to be monitored for 30 days and in some cases even 90 days, which means that patients must be followed up also after hospital discharge. Studies indicate that post-discharge monitoring makes it possible to identify significantly more SSI cases than monitoring performed during hospitalization (SSI index: 2.61% *vs* 6.34%) [55]. In order to maintain the continuity of care post-discharge, patients should be provided with information about the principles of outpatient care, and instructed on how to act in the event of alarming symptoms in the wound area. Patient education with respect to post-discharge self-observation should take into account individual SSI aspects related to the specific type

and nature of the procedure, e.g. risk of dehiscence after extensive abdominal procedures, symptoms of vascular prosthesis/stent graft infection, late pacemaker pocket infection or symptoms of endocarditis after cardiac surgery [18, 58]. Prior to hospital discharge, the nurse should provide the patient with easy-to-understand information (also written instructions) on how to care for the wound at home [58].

It is especially important to address aspects of hygiene and alert the patients to the need to follow a set of rules during changes of wound dressing:

- Wash hands thoroughly with warm water and soap before and after changing the dressing.
- Prepare equipment and dressing materials according to recommendations (if scissors will be used, disinfect and dry them beforehand).
- Wear protective gloves when changing the dressing by your own.
- Immediately discard contaminated waste, i.e. dressing removed from the wound, gauze pads applied for cleaning the wound, used gloves, into a separate bag, secure the bag (e.g. by binding), and place in the waste bin.
- Clean the wound with a sterile gauze pad wetted in a sterile 0.9% NaCl solution and cover the surface with a dry gauze compress (avoid touching the contact side) and fix it to the skin, e.g. with an adhesive bandage (when using specialist dressings, follow the instructions adjusted to dressing type).
- Apply an antiseptic or antiseptic gauze pads only in the event of healing complications.
- Do not apply any medicinal products (e.g. ointments, creams, antibiotics) to the wound.
- Change the dressing once a day of more frequently, if the dressing becomes soiled or wetted, or detached from the skin (in the case of gauze compresses) for a period specified in the discharge report; primarily healing wounds usually require dressing changes for two days after the procedure, unless the wound is in a location that is irritated by clothing or exposed to sunlight, or early wound uncovering is not comfortable to the patient (in such cases, the duration of wound dressing should be set on an individual basis).
- Monitor the wound and the wound area for local signs of infection; monitor well-being and check body temperature; if any alarming symptoms develop, make an appointment at the outpatient clinic.

Practical implications

The nurse is responsible for instructing the patient and/or the patient's family on how to handle the postoperative wound at home and when a consultation with a surgeon is necessary. Before the patient is discharged home, the nurse evaluates the patient's preparation for self-care and self-control, and provides the patient with written educational materials.

References

1. Cwajda-Białasik J, Szewczyk MT, Mościcka P, et al. Znaczenie edukacji i opieki pielęgniarskiej w profilaktyce długoterminowej zakażenia miejsca operowanego. Część 1. Rola pielęgniarki podstawowej opieki zdrowotnej i pielęgniarki chirurgicznej w przygotowaniu chorego do planowego zabiegu operacyjnego. Forum Zakażeń 2014; 5: 217-223.
2. Mangram AJ, Horan TC, Pearson ML, et al. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC). Hospital Infection Control Practices Advisory Committee. Am J Infect Control 1999; 27: 97-132.
3. Rozporządzenie Ministra Zdrowia z dnia 27 maja 2010 r. w sprawie kwalifikacji członków zespołu kontroli zakażeń szpitalnych (Dz. U. Nr 108 poz. 706).
4. Łabuńska A, Cierzniakowska K, Szewczyk MT. Okołooperacyjna opieka pielęgniarska w chirurgii naczyniowej. In: Pielęgniarstwo angiologiczne. Szewczyk MT, Jawień A (eds.). Termedia, Poznań 2010; 35-53.
5. Ciuruś M. Higiena rąk obowiązkiem personelu mającego kontakt z pacjentami. Forum Zakażeń 2013; 4: 199-205.
6. Montewka M, Skrzek A, Plewik D, et al. Zakażenia miejsca operowanego – charakterystyka czynników ryzyka, endogennych źródeł zakażenia i metody zapobiegania. Post Mikrobiol 2012; 51: 227-235.
7. Harzowska J, Kózka M. Czynniki wpływające na występowanie hipotermii w okresie pooperacyjnym. Piel Chir Angiol 2011; 2: 47-53.
8. Torrosian A. Thermal management during anesthesia and thermoregulation standards for the prevention of inadvertent perioperative hypothermia. Best Practice Res Clin Anesthesiol 2008; 22: 659-668.
9. Czaja E. Hipotermia. In: Diagnozy i interwencje pielęgniarskie. Kózka M, Płaszewska-Żywko L (ed.). Wydawnictwo Lekarskie PZWL, Warszawa 2008.
10. Surgical Site Infection: Prevention and Treatment of Surgical Site Infection. NICE guidelines [CG74], October 2008. NICE (online) 2008. Dostępne na: http;//www.nice.org.uk/Guidance/CG74.
11. American Diabetes Association standards of medical care in diabetes: 2008. Diabetes Care 2008; 31 (Suppl 1): S12-S54.
12. Zalecenia kliniczne dotyczące postępowania u chorych na cukrzycę, 2014. Stanowisko Polskiego Towarzystwa Diabetologicznego. Diabetologia Kliniczna 2014; 3 (supl. A). (online) http://www.dk.viamedica.pl.
13. Furnary AP, Wu Y, Bookin SO. Effect of hyperglycemia and continuous intravenous insulin infusions on outcomes of cardiac surgical procedures: the Portland Diabetic Project. Endocr Pract 2004; 10 (Suppl. 2): 21-33.
14. Alexander JW, Solomkin JS, Edwards MJ. Updated recommendations for control of surgical site infections. Ann Surg 2011; 253: 1082-1093.
15. Toon CD, Ramamoorthy R, Davidson BR, Gurusamy KS. Early versus delayed dressing removal after primary closure of clean and clean-contaminated surgical wounds. Cochrane Database Syst Rev 2013; 9: CD010259.
16. Toon CD, Sinha S, Davidson BR, Gurusamy KS. Early versus delayed post-operative bathing or showering to prevent wound complications. Cochrane Database Syst Rev 2013; 10: CD010075.
17. Dayton P, Feilmeier M, Sedberry S. Does postoperative showering or bathing of a surgical site increase the incidence of infection? A systematic review of the literature. J Foot Ankle Surg 2013; 52: 612-614.
18. Surgical Site Infection (SSI) Event. Centers for Diesease Control and Prevention (online) 2014. Dostępne na: http://www.cdc.gov/nhsn/PDFs/pscmanual/9pscssicurrent.pdf.
19. Akagi I, Furukawa K, Miyashita M, et al. Surgical wound management made easier and more cost-effective. Oncol Lett 2012; 4: 97-100.
20. Gregorowicz-Warpas D, Pałubicka A, Wolski A, et al. Czyste powietrze w salach operacyjnych. Materiały szkoleniowe dla pielęgniarek epidemiologicznych. Zeszyt IV. Wrocław 2005.
21. Dzierżanowska D. Patogeny bakteryjne zakażeń szpitalnych. In: Zakażenie szpitalne. Dzierżanowska D (ed.). &-medica Press, Bielsko-Biała 2008; 90: 297-339.
22. Podstawy pielęgniarstwa epidemiologicznego. Fleischer M, Bober-Gheek B (red.). CKPPiP, Warszawa 2002; 299-428.
23. Klemens M, Edwards J, Richards Ch, et al. Estimating health care – associated infections and deaths In U.S. hospitals, 2002. Public Health Rep 2007; 122: 160-166.
24. Sierocka A, Cianciara M. Monitorowanie zakażeń szpitalnych. Problemy Hig Epidemiol 2010; 91: 323-328.
25. Dumville JC, Walter CJ, Sharp CA, Page T. Dressings for the prevention of surgical site infection. Cochrane Database Syst Rev 2011; (7): CD003091.
26. Walter CJ, Dumville JC, Sharp CA, Page T. Systematic review and meta-analysis of wound dressings in the prevention of surgical-site infections in surgical wounds healing by primary intention. Br J Surg 2012; 99: 1185-1194.
27. Arroyo AA, Casanova LP, Soriano VJ, et al. Open-label clinical trial comparing the clinical and economic effectiveness of using a polyurethane film surgical dressing with gauze surgical dressings in the care of postoperative surgical wounds. Int Wound J 2013. Dostępne na: http://onlinelibrary.wiley.com/doi/10.1111/iwj.12099/pdf.
28. Clark JV, Deakin AH, Dillon JM, et al. A prospective clinical audit of a new dressing design for lower limb arthroplasty wounds. J Wound Care 2009; 18: 5-11.
29. Emmerson S, Dillon J, Clarke J, Kinninmonth A. The jubilee method: a modern dressing desing which reduces complication following total ship and knee arthroplasty. Glasgow 2-4 May 2007. Ewidence, Consensus and Driving the Agenda forward. EWMA 2007.
30. Burke NG, Green C, McHugh G, et al. A prospective randomised study comparing the jubilee dressing method to a standard adhesive dressing for total hip and knee replacements. J Tissue Viability 2012; 21: 84-87.
31. Rowley S, Clare S. ANTT: a standard approach to aseptic technique. Nurs Times 2011; 107: 12-14.
32. Centres for Disease Control and Prevention – Guidelines for the Prevention of Intravascular Catheter-Related Infecvtions, 2011.
33. Zestaw podstawowych wymogów pielęgnacji wkłucia centralnego i obwodowego. Bundle of care. Materiały szkoleniowe dla pielęgniarek epidemiologicznych. Katowice 2012.
34. Jawień A, Bartoszewicz M, Przondo-Mordarska A, et al. Wytyczne postępowania miejscowego i ogólnego w ranach objętych procesem infekcji. Leczenie Ran 2012; 9: 59-75.
35. Dissemond J, Assadian O, Gerber V. Classification of wounds at risk and their antimicrobial treatment with polihexanide: a practice-oriented expert recommendation. Skin Pharmacol Physiol 2011; 24: 245-255.
36. Patel S. Investigating wound infection. Wound Essentials 2010; 5: 40-47.
37. Hryniewicz W, Kulig J, Ozorowski T, et al. Stosowanie antybiotyków w wybranych zakażeniach skóry i tkanek miękkich. Narodowy Instytut Leków. Narodowy Program Ochrony Antybiotyków, Warszawa 2012.
38. Harding K, Carville K, Cuddigan J, et al. (Expert Working Group). World Union of Wound Healing Societies (WUWHS). Principles of best practice: wound infection in clinical practice. An international consensus. MEP Ltd, London 2008.
39. Bowler PG, Duerden BI, Armstrong DG. Wound microbiology and associated approaches to wound management. ClinMicrobiol Rev 2001; 14: 244-269.
40. Hryniewicz W, Kulig J, Ozorowski T, et al. Stosowanie antybiotyków w profilaktyce okołooperacyjnej. Narodowy Program Ochrony Antybiotyków, Warszawa 2011.
41. Davis SC, Ricoti C, Cazzaniga A, et al. Microscopic and physiologic evidence for biofilm-associated wound colonization in vivo. Wound Rep Reg 2008; 16: 23-29.
42. Kaftandzieva A, Cekovska Z, Kaftandziev I, et al. Bacteriology of wound – clinical utility of Gram stain microscopy and the correlation with culture. Maced J Med Sci 2012; 5: 72-77.

43. Uppal SK, Ram S, Kwatra B, et al. Comparative evaluation of surface swab and quantitative full thickness wound biopsy culture in burn patients. Burns 2007; 33: 460-463.
44. Vural MK, Altoparlak U, Celebi D, et al. Comparison of surface swab and quantitative biopsy cultures dependent on isolated microorganisms from burn wounds. Eurasian J Med 2013; 45: 34-38.
45. Feilmeier M, Dayton P, Sedberry S, et al. Incidence of surgical site infection in the foot and ankle with early exposure and showering of surgical sites: a prospective observation. J Foot Ankle Surg 2014; 53: 173-175.
46. Wukich DK, McMillen RL, Lowery NJ, Frykberg RG. Surgical site infections after foot and ankle surgery: a comparison of patients with and without diabetes. Diabetes Care 2011; 34: 2211-2213.
47. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Centers for Disease Control and Prevention. MMWR 2002; 51(RR-16): 1-45; (online). Dostępne na: http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf.
48. WHO Guidelines on Hand Hygiene in Health Care. First Global Patient Safety Challenge Clean Care is Safer Care. World Health Organization 2009 (online). Dostępne na: http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf.
49. Laupland K, Bagshaw S, Gregson D, et al. Intensive care unit- acquired urinary tract infections in a regional critical care system. Critical Care 2005; 9: R60-R65.
50. Alvarez-Lerma F, Gracia-Arnillas MP, Palomar M, et al. Grupo de Investigadores del Estudio Nacional de Vigilancia de Infección Nosocomial en UCI. Urethral catheter-related urinary infection in critical patients admitted to the ICU. Descriptive dataof the ENVIN--UCI study. Med Intensiva 2013; 37: 75-82.
51. Gandhi T, Flanders S, Markovitz E, et al. Importance of urinary tract infection to antibiotic use among hospitalized patients. Infect Control Hosp Epidemiol 2009; 30: 193-195.
52. Rosenthal V, Maki D, Salomao R, et al. Device – associated nosocomial infections In 55 intensive care units of 8 developing countries. Ann Intern Med 2006; 145: 582-586.
53. Ciuruś M. Przygotowanie pacjenta do zabiegu jako proces redukcji ryzyka zakażenia miejsca operowanego. Forum Zakażeń 2014; 5: 171-176.
54. Jumaa PA. Hand hygiene: simple and complex. Int J Infect Dis 2005; 9: 3-14.
55. Szczypta A, Bulanda M. Nadzór nad zakażeniami miejsca operowanego. Forum Zakażeń 2012; 3: 187-194.
56. Ustawa z dnia 5 grudnia 2008 r. o zapobieganiu oraz zwalczaniu zakażeń i chorób zakaźnych u ludzi (Dz. U. z 2008 r. Nr 234 poz. 1570).
57. Gospodarek E, Szopiński J, Mikucka A. Zakażenie miejsca operowanego – postaci kliniczne, czynniki ryzyka, profilaktyka, etiologia, diagnostyka. Forum Zakażeń 2013; 5: 275-282.
58. Karwacka M, Mączyńska AT, Świerczyńska B. Przygotowanie pacjenta do zabiegu operacyjnego jako profilaktyka zakażeń miejsca operowanego. Forum Zakażeń 2013; 4: 73-76.
59. O'Grady NP, Alexander M, Burns LA, et al.; Healthcare Infection Control Practices Advisory Committee (HICPAC) (Appendix 1). Summary of recommendations: Guidelines for the Prevention of Intravascular Catheter-related Infections. Clin Infect Dis 2011; 52: 1087-1099.
60. Bartoszewicz M, Junka A, Smutnicka D, et al. Mikrobiologiczny aspekt skali oceny rany zagrożonej ryzykiem infekcji W.A.R. Forum Zakażeń 2011; 2: 85-88.
61. Longrois D, Hoeft A, De Hert S. 2014 European Society of Cardiology/European Society of Anaesthesiology guidelines on non--cardiac surgery: cardiovascular assessment and management: A short explanatory statement from the European Society of Anaesthesiology members who participated in the European Task Force. European Journal of Anaesthesiology 2014; 31: 517-573.
62. Fernandez R, Griffiths R, Ussia C. Effectiveness of solutions, techniques and pressure in wound cleansing. International Journal of Evidence-Based Healthcare 2004; 2: 231-270.

Załączniki

Annex 1. Stages involved in ANTT-based change of dressing in clean postoperative wounds in the surgery room

Preparation of necessary equipment and dressing materials.
Movement/transfer of the patient from the patient room to the surgery room.
Hygienic disinfection of hands, putting on (non-sterile) gloves.
Patient preparation: – obtaining access to and exposing the wound area, – assistance with assuming a comfortable body position, – placement of a sterile surgical drape under the wound area.
Removal of "dirty" dressing from the wound and its disposal directly into a bag designated for contaminated waste (must be located within a hand's reach). Removal of gloves without touching contaminated surfaces.
Hygienic disinfection of hands after the removal of gloves.
Putting on (sterile) gloves.
Wound cleaning with a gauze pad – moistened with sterile saline, – following the rule of "one gauze pad, one stroke".
Placement of a new dressing without touching its key parts which are in direct contact with the wound.
Disposal of used equipment and waste into appropriate bags/containers. Removal of gloves.
Hygienic disinfection of hands after the removal of gloves.
Walking/transport of the patient back to the patient room.
Tidying up of the work site. Disinfection of working surfaces.
Washing and/or hygienic disinfection of hands.
Important: – sterile elements of the kit must only be used once; after use, they must be immediately disposed into the waste bag, – sterile elements must not come into contact with non-sterile elements, – only sterile materials/surfaces can be in contact with "key sites", e.g. the wound surface.

Annex 2. General rules of maintaining peripheral and central vascular access devices

Maintenance aspects	Peripheral cannula	Central vascular line
Catheter placement (according to manufacturer's instructions)	– in a site that does not interfere with patient's mobility and ensures optimum stability of the cannula in blood vessel – in surgery room or patient room	– preferred site: subclavian area [59] – in operating room or appropriate surgery room with a suitable cleanliness regime
Hand hygiene	– washing or hygienic disinfection of hands before and after every procedure – clean disposable gloves are recommended	– washing or hygienic disinfection of hands before and after every procedure – sterile disposable gloves are recommended
Barrier measures	– aseptic no-touch technique is recommended – universal barrier measures including clean disposable gloves – personal protective equipment: eye and face protection in situations involving risk of contamination with blood/body fluids–	– aseptic no-touch technique is recommended – sterile uniform, sterile gloves, face mask and cap, and large drape covering the entire patient during catheter placement – personal protective equipment: eye and face protection in situations involving risk of contamination with blood/body fluids
Skin preparation	– hair removal using surgical clipper, if necessary – skin antiseptic with a dedicated agent	– hair removal in the site of central catheter insertion (using surgical clipper), if necessary – skin antiseptic
Dressing	– preferably sterile transparent semi-permeable dressing to allow monitoring of the insertion site (to be changed at least every 7 days) – or non-woven dressing (to be changed at least every 48 hours) – skin antiseptic before placing a new dressing – antiseptic ointments, acetone and petroleum products should not be used	– sterile transparent semi-permeable dressing is recommended to allow monitoring of the insertion site (to be changed at least every 7 days) – skin antiseptic during each change of dressing – antibacterial dressings should not be used in all patients on a routine basis – antiseptic ointments, acetone and petroleum products should not be applied to the vascular access site
Monitoring	– daily visual and tactile checks (through the dressing) for symptoms of inflammation – checks to assess stability of cannula fixation	– daily checks of insertion site for signs of infection – check to assess cannula positioning and fixation
Catheter replacement/removal	Performed by a nurse: – No need to replace peripheral catheter more frequently than every 72-96 hours to reduce the risk of infection and phlebitis in adult patients. – Peripheral catheter must be removed in patients developing symptoms of phlebitis (warmth, tenderness, erythema or palpable venous cord), infection or catheter malfunction. – Peripheral catheters in children should not be replaced unless clinical indications occur.	Performed by a physician depending on indications: – Central catheters should not be replaced on a routine basis as a means of preventing catheter-related infections. – Catheter should be removed immediately when no longer needed. – Microbiological analysis of catheter tip should always be performed in cases of suspected infection (based on the clinical picture).
Anticoagulation treatment	Anticoagulation treatment should not be performed in patients from the general population on a routine basis as a means of reducing the risk of catheter-related infections [59].	

Annex 3. W.A.R. (Wounds At Risk) Scale [34]

Risk class	Definition	W.A.R. points
I	– Acquired immunosuppressive disease (e.g. diabetes mellitus) – Acquired immune defect due to medical therapy (e.g. with cyclosporine, methotrexate, glucocorticoids or antibodies) – Solid tumour disease – Systemic haematological disease – Postsurgical wound healing disorder which results in (unplanned) secondary healing – Potentially heavily contaminated wounds (e.g. perineum, genitals) – Problematic hygienic conditions related to social or occupational environment – Patient age >80 years – Young age of patient (premature infants, babies, infants) – Wounds persisting for > 1 year – Wound dimensions of > 10 cm^2 – Chronic wounds of any aetiology having a depth of > 1.5 cm – Extended inpatient status >3 weeks	The presence of each risk factor adds 1 risk point (multiple responses are possible). The points are added.
II	– Severe acquired immune defects (e.g. HIV infection) – Heavily contaminated acute wounds – Bite, stab and gunshot wounds penetrating 1.5–3.5 cm	The presence of each risk factor adds 2 risk points (multiple responses are possible). The points are added.
III	– Burn wounds with involvement of >15% BSA – Wounds that have a direct connection to organs or functional structures (e.g. including joints) or which contain foreign material – Severe congenital immune defects such as agammaglobulinaemia – Bite, stab and gunshot wounds penetrating > 3.5 cm	The presence of each risk factor adds 3 risk points (multiple responses are possible). The points are added.
A score of ≥ 3 points indicates the presence of a wound at risk of infection. Consequently, suitable therapeutic measures must be undertaken [34]		

Annex 4. Recommendations for hygienic washing and disinfection of hands (based on CDC, WHO) [5, 47, 48]

Recommendation	Rationale
Remove jewellery (finger rings, wedding rings, watches, bracelets) before beginning hygienic hand washing	Wearing rings facilitates colonization of skin on the hands with Gram-negative rods including *Enterobacteriacea*
Wear short-sleeved work clothes (long-sleeved garments – disposable type only – are recommended in special circumstances, e.g. in patients who are infected or contaminated with biological material)	Wearing watches, bracelets and long-sleeved uniforms makes it more difficult to effectively decontaminate the skin on the hands and in the wrist area
Fingernails must be clipped short and clean	The free edge of the nail plate has been shown to be colonized by coagulase-negative staphylococci, Gram-negative rods, corynebacteria and yeast-like fungi
Do not wear nail polish	– Chipped nail polish, appliqués and protruding nail decorations prevent effective hand washing and disinfection, and increase bacterial colonization of the skin on the hands – Female healthcare workers wearing nail polish tend to avoid washing and disinfecting hands (disinfectants reduce the lifespan of nail polish)
Do not wear artificial fingernails (extenders) during work	– Focal infections (e.g. *Klebsiela pneumoniae, Pseudomonas aeruginosa*) transmitted by artificial nail wearers have been identified – It is not possible to thoroughly disinfect the area where artificial nails are attached to the nail plate
When soiled with an organic material (faeces, blood, pus, vomit), clean the hands with a disposable antiseptic wipe and then proceed to washing/disinfecting	
Moisten the hands with a little lukewarm water before applying the cleaning agent	– The procedure facilitates foaming and even distribution of the cleaning agent on the hands – The cleaning agent is diluted, which reduces the risk of skin irritation
Apply a palmful of the cleaning or disinfecting agent in a cupped hand (approx. 3 ml, equivalent to 2 doses)	– Two doses are necessary to obtain an appropriate amount of foam and complete all stages of hand washing (soap) – Two doses ensure that the entire surface of the hands is covered and all stages of disinfection are completed (disinfecting agent) – A greater amount of the product (several doses) increases consumption levels and costs without improving the effectiveness of the procedure
Observe hand washing and disinfection times defined in the EN 1499 standard: hygienic hand washing – 1 minute hand rinsing – 15 seconds and the EN 1500 standard: hygienic hand disinfection – 30-60 seconds	– Performing all stages of the procedure takes precisely the amount of time defined in the procedure
After hand washing, thoroughly rinse the foam off and remove residues of the cleaning agent (soap) Dry the hands thoroughly with a disposable towel	– Rinsing off the foam reduces the risk of skin colonization with microbial strains multiplying in soap molecules – Drying the hands increases the effectiveness of the disinfecting agent and prevents its dilution during hygienic hand washing
Rub the product for hygienic hand disinfection into the skin until dry	– Wiping the product with a towel reduces the effectiveness of the disinfection procedure – Putting on gloves on wet hands increases the risk of skin irritation and disinfectant-related burns
Follow the Ayliffe technique of hand washing and disinfection	