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Catheter Selection in Home Parenteral Nutrition Patients and Noteworthy Definitions in The Diagnosis of Catheter Infections

Evde Parenteral Nütrisyon Hastalarında Kateter Seçimi ve Kateter Enfeksiyonu Tanısında Öne Çıkan Tanımlar

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ABSTRACT
The rising number of patients in need of long-term parenteral nutrition has necessitated home parenteral nutrition. Extended usage of central venous catheters and parenteral nutrition has given rise to its own complications. Among them, catheter-related bloodstream infections (CRBSI) are linked to life-threatening complications, especially sepsis, septic shock, and metastatic infections. The principal objective of this review is to define diagnostic methods, notable clinical and laboratory findings, and catheter salvage strategies towards preventing CRBSI, which include defining and interpreting blood culture and its results, its confounding variables and common shortcomings in routine practice. We will discuss the types and relative advantages and disadvantages of differing methods of central venous access and compare the common diagnostic definitions used by existing guidelines. CRBSI remains a serious complication, and we aim to debate when timely intervention will be necessary in light of the existing literature.
Keywords: Catheter-related infections; parenteral nutrition, home; sepsis

ÖZ
Uzun süreli parenteral beslenmeye ihtiyaç duyan hasta sayısının artması, evde parenteral beslenmeyi zorunlu hale getirmiştir. Uzun süreli santral venöz kateter kullanımı ve parenteral beslenme kendi komplikasyonlarına yol açmıştır. Bunlar arasında kateterle ilişkili kan dolaşımı enfeksiyonları (KİKDE), özellikle sepsis, septik şok ve metastatik enfeksiyonlar gibi yaşamı tehdit eden komplikasyonlarla ilişkilidir. Bu derlemenin ana odağı, kan kültürünün ve sonuçlarının tanımlanması ve yorumlanması, kafa karıştırıcı değişkenler ve rutin uygulamadaki yaygın eksiklikler, KİKDE'yi önlemeye yönelik tanımlar, tanı yöntemleri, önemli klinik ve laboratuvar bulguları ve kateter kurtarma stratejileridir. Farklı santral venöz erişim yöntemlerinin türlerini, göreceli avantaj ve dezavantajları ve mevcut kılavuzların kullandığı tanı kriterleri kıyaslanacaktır. KİKDE ciddi bir komplikasyon olmayı sürdürmektedir ve mevcut literatür ışığında zamanında ivedi müdahalenin ne zaman gerekli olacağını tartışmayı amaçlıyoruz.
Anahtar Kelimeler: Evde parenteral nütrisyon, kateter ilişkili enfeksiyon, sepsis

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INTRODUCTION

Long-term Central Venous Catheter (CVC) application was first begun in 1973 by Dr. Broviac. Implanted Ports were developed in 1982, and multiple lumen catheters were developed in 1983.1 At first, CVCs were used for central venous pressure monitoring, hyperalimentation and bone marrow transplantations.[2] Later, they began to be used for haemodialysis, ICU, chemotherapy and long-term parenteral nutrition. Peripherally inserted central catheters (PICC), tunnelled and non-tunnelled catheters and port systems were developed for convenience. But despite the benefits of catheter use, their infectious and non-infectious complications continue to pose problems.

Parenteral nutrition (PN) encompasses the methods used for parenteral supplementation of macronutrients and micronutrients in cases where enteral nutrition (EN) is inapplicable or insufficient. Long-term PN has necessitated home parenteral nutrition (HPN). It's known that PN products also contribute to catheter usage complications.[3]

Intestinal failure (IF) was defined in 1981 by Fleming and Remington as "a reduction in the functioning gut mass below the minimal amount necessary for adequate digestion and absorption of nutrients".[4] IF is defined as gut function below the requisite threshold for the absorption of macronutrients and/

or electrolytes to the point of requiring intravenous intervention in order to continue health and/or growth.[5] A gut function reduction that does not require any intravenous (IV) intervention for continued health and/or growth is considered as intestinal insufficiency. IF is classified under; functional classification (type 1 acute and short-term conditions, type 2 prolonged acute conditions and type 3 potentially chronic conditions), pathophysiological classification (short bowel, intestinal fistula, intestinal dysmotility, mechanical obstruction and extensive small bowel mucosal disease), clinical classification (on the basis of requirements for energy and the volume of IV supplementation), anatomical classification (end-jejunostomy with no colon in continuity, jejunocolic anastomosis with no ileo-cecal valve and a part of the colon in continuity, and jejunoileal anastomosis with both the ileo-cecal valve and the entire colon in continuity). Patients with irreversible IF are most likely to need long-term or lifelong HPN or intestinal transplantation.[6]

Therefore, for some patients, HPN therapy is a vital treatment. In the treatment of HPN, CVCs and PVCs play a critical role. However, catheter-related bloodstream infections (CRBSI) are linked to life-threatening complications, especially sepsis, septic shock, and metastatic infections.[7,8]

The primary focus of this review is definitions, diagnostic methods, notable clinical and laboratory findings and catheter salvage strategies towards preventing CRBSI. Ethics committee approval was not obtained. The editor invited me to review. Ethics committee approval is not required.

TYPES OF CATHETERS

Although peripheral application appears suitable for short-term PN, the requirement for high-volume, high-osmolality nutrition, the inability of peripheral cannulas to remain open for longer than 14-21 days, the fact that many patients requiring HPN have damaged peripheral vessels and the risk of thrombophlebitis means peripheral application seems inappropriate for PN. This necessitated the development of central venous access catheters despite their own life -threatening risks.[9]

Venous access via large diameter veins and high rate of flow has begun with arterio-venous shunts and was further developed through teflon, silicone and elastomer catheters.[10]

Catheters developed for PN applications are examined in two groups: peripheral and central. Peripheral venous catheters (PVC) are placed within veins of the forearm or hand for very short-term use. Midline catheters (MC) and long peripheral catheters (LPC) (7.6–20.3 cm long that do not reach the central veins, for use longer than 6 days and are limited to weeks) are used by placing them into the proximal basilic or cephalic veins through the antecubital fossa. CVCs are for short-term use (non-tunnelled) and PCVC (reaches the superior vena cava through the cephalic and basilic veins) and for long-term use (tunnelled) and ports.[11]

Catheters are classified based on their compositions as Teflon, silicone, polyurethane, polyvinyl chloride or polyethylene. Polytetrafluoroethylene (Teflon) or polyurethane catheters are correlated with fewer infectious complications compared to polyvinyl chloride or polyethylene catheters. Steel needles used for peripheral venous access as an alternative to catheters have the same risk of infectious complications as Teflon catheters.[12,13] The development of silicone catheters has reduced the risk of complications.[14]

PVC's MC; 20 cm and LPC (3 Fr, 8 cm; 4 Fr, 10 cm; 4 Fr, 18 cm) are polyethylene in structure.[15,16] In suitable patients, they might be correlated with fewer complications when compared to CVCs, but the risk of catheter infection should be considered.[17]

PCVC can be recommended in elderly or patients otherwise considered unable to use the catheter, patients with Short Bowel Syndrome (SBS) with gut continuity reconstruction planned in 3-6 months, and patients with malignancy (with expected remaining lifespan over 2-3 months).[10]

Broviac and Hickman's catheters are similarly structured catheters with different lumen diameters. The lumen diameter of paediatric Broviac's' is 0.12 mm, Broviac catheters' is 0.2 mm, and Hickman catheters' is 0.32 mm. Additionally, the external side of the Hickman catheter does not have a Teflon covering. Hickman catheter is primarily used in patients who often require chemotherapeutic agents or blood and blood product transfusions and require frequent blood draws.[18] Broviac catheter is 90 cm in length and crafted from silicone rubber (Silastic). The intravenous segment of the catheter is thin and elastic enough to float inside the superior vena cava. It is tied to a thicker extravascular segment through a Dacron cuff. The extravascular portion is stationed inside a subcutaneous tunnel. Dacron cuff causes a fibrotic tissue formation which ensures better adhesion of the catheter and contributes to the barrier formation against the passage of microorganisms.[19]

Surgically implanted totally implantable venous access devices (TIVADs) are comprised of a tunnelled silicone catheter and a subcutaneously implanted port reservoir.[11] Implantable systems have the advantages of a better cosmetic appearance, less migration, less occlusion and fewer catheter infections. The port reservoir consists of a stainless-steel chamber, conically shaped, with an inner diameter measuring 1.02 mm and an outer diameter of 2.8 mm, an inner volume of 0.4 ml, and a self-sealing membrane made of silicone rubber that may be

pierced up to 2000 times with a 22 GA Huber needle, and which is connected to the cone and then connected to a small, stainless-steel chamber. It features a silicone rubber radiopaque catheter blocked by a steel cylinder. This technique is recommended in patients that don't need HPN every day.[20]

Arteriovenous fistula could be used when long-term home parenteral nutrition is necessary. But in this regard sufficient evidence does not exist for clear recommendations. It may be deemed appropriate for specific patients to prevent catheter-related infections.[12,21]

CATHETER SELECTION AND INSERTION

For non-tunnelled catheters left-side subclavian path is preferred due to minimal infection risk. In contrast, for tunnelled catheters, although no priority insertion path is recommended (subclavian, internal jugular, external jugular), the left-sided subclavian catheter can be preferred due to less mobility (except haemodialysis and advanced renal failure patients). The femoral path is relatively contraindicated due to thrombosis and infection risk. The minimum amount of lumened catheters and the use of ultrasound during catheter insertion lowers the risk of complications.[7,13,19] Catheter choice should be made in accordance with the duration of the intravenous treatment. PCVCs are generally preferred in patients requiring short-term (<3 months) HPN treatment. Due to the risk of CRBSI, tunnelled catheters are most frequently preferred.[8,13]

CATHETER-RELATED BLOODSTREAM INFECTIONS

For some patients, i.e., those with specific medical conditions such as short bowel, HPN therapy is a vital treatment. In the treatment of HPN, CVCs and PVCs play a critical role. However, catheter-related bloodstream infections (CRBSI) are linked to life-threatening complications, especially sepsis, septic shock, and metastatic infections.[7,8]

CRBSIs may arise from bacterial or fungal origins, but the majority of these problems arise from the patient's skin flora. The area where the catheter comes into contact with the skin is considered a frequent cause of endo-luminal (inside the catheter) infections, while infections originating from the catheter exit site or tunnel tract are regarded as extra-luminal (outside the catheter) infections in nature. CRBSIs are also categorised based on the total span of the episodes as transient, intermittent or persistent (sustained transfer of microorganisms into the bloodstream from an intravascular source) and community- or hospital-acquired (detected within 72 hours of hospitalization).[22–24]

Extra-luminal catheter related infections typically occur within the initial week of catheter insertion. Internal lumen infections generally occur after a week as the number of manipulations increases. The onset of infection in long-term catheters usually occurs within a span of 10 days, indicating that the inner lumen is the leading site for CRBSI.

This article focuses on the definition and management of CRBSIs, aiming to provide a scientific guide to the effective handling of such infections.[6,11,13,14,25]

Table 1. Definitions.

Terminology	Definition
Phlebitis	Erythema, temperature increase, and pain or tenderness are detected in the path of a catheterized vessel.
External Site Infection	Redness, swelling, and/or pain within 2 cm of the catheter exit site. It may also contain microbiological findings.
Tunnel Infection	Tenderness, erythema and/or swelling are detected in the subcutaneous path of the tunnel catheter more than 2 cm from the catheter exit point.
Pocket Infection	Infected fluid is present in the subcutaneous compartment of a fully implanted intravascular device.
Catheter Colonization	Significant growth of microorganisms on the tip of the catheter, subcutaneous portion of the catheter or catheter hub.
Infection Related to Possible LCBSI	It is defined when there are no signs of systemic or local infection despite the presence of microorganisms in blood cultures taken from samples.
Bloodstream Infection	- Infusate Related: Suspicion regarding contaminated infusion should arise when there is no other infection that could explain BSI or when the sudden onset of shock occurs during parenteral drug or fluid infusion. - Catheter-Related: CRI is a clinical condition manifested by clinical symptoms, biochemical infection parameters and blood culture positivity.
Recovery	It is defined as clinical and biochemical improvement 1 to 2 weeks after discontinuation of CRBSI antibiotherapy.
Relapse Infection	It means reinfection within 30 days. It is defined as an infection arising within the next 30–100 days with the same causative pathogen and an identical antibiogram.
Complicated CRI	It is considered complicated when persistent fever (72 hours), positive follow-up blood cultures (48 hours), septic shock (septic) thrombophlebitis, endocarditis, and/or other metastatic infectious foci are present.

LCBSI: Laboratory Confirmed Bloodstream Infection; MBI-LCBSI: Laboratory Confirmed Bloodstream Infection with Mucosal Barrier Injury; BSI: Bloodstream Infection; CRI: Catheter-Related Infection; CRBSI: Catheter-Related Bloodstream Infection; NHSN: National Healthcare Safety Network; CVC: Central Venous Catheter; CVC-BSI: Central Venous Catheter-Related Bloodstream Infection; IWP: Infection Window Period; ED: Event Date.

Table 1. Continue.

CVC Rescue	Preservation of venous access during a CRI. It is considered successful if the catheter remains for at least 60 days after starting CRI treatment and there is no recurrence or relapse.
Infection Window Period (IWP)	It is defined as 7 consecutive days during which all criteria for site-specific infection must be fulfilled. This period encompasses the collection date of the initial positive diagnostic test. 3 calendar days before and 3 calendar days after are used as an element that meets site-specific infection criteria.
Event Date (ED)	The first date on which the first element is used to meet an NHSN site-specific infection criterion occurs within the seven-day infection window period. If the OT is determined to be one of the two days before hospitalization, the date of the event is considered admission day 1.
Healthcare-Associated Infection (HAI)	An infection is considered a healthcare-associated infection (HAI) if the event date is considered on or after calendar day 3 of admission to an inpatient facility.
Secondary BSI Attribution Time	The amount of time a blood sample must be collected before a secondary bloodstream infection can be attributed to a primary site infection. It is 14-17 days long, depending on the date of the event (3 days before, 13 days after the event)
Recurrent Infection Time Period (RITP)	A period of 14 days in which no new infections of the same type are reported. The date of the event is Day 1 of the 14-day RITP. If criteria are met for the same type of infection and the event date is within a 14-day RIT, it will not be considered a new event.
Primary BSI	LCBSI is not secondary to an infection in another body site. (Secondary Specific Types of Infections, urinary tract infection, pneumonia, and surgical site infection).
Secondary BSI	A BSI is considered to originate from a site-specific infection in another body part.
CVC-BSI	Indicates LCBSI where a suitable BSI organism has been identified and a suitable central line is present at or the day before the LCBSI ED. In cases where LCBSI criteria are met, MBI-LCBSI status should be evaluated.
LCBSI 1	Identified by a culture obtained from one or more blood samples OR identified to the genus or species level by non-culture-based microbiological testing. The organism(s) detected in the bloodstream are not associated with infection at another site.
LCBSI 2	A patient of any age that exhibits at least one of the following signs or symptoms: fever (>38.0 °C), chills, or hypotension AND the organisms identified in the blood are not associated with infection at another site AND cultures are obtained from two or more blood samples collected on separate occasions. The criteria elements must occur within the 7-day IWP from the date of collection of the positive blood sample.
LCBSI 3	A patient younger than one year of age exhibiting at least one of the following signs or symptoms: fever (>38.0 °C), hypothermia (<36.0 °C), apnea, or bradycardia AND the organism(s) identified in the blood are not associated with infection at another location AND criterion items must occur within the 7-day IWP.
MBI-LCBSI	A BSI event must fully meet the criteria for an LCBSI before considering the corresponding MBI-LCBSI criteria. MBI-LCBSI ED will always be the date on which the prerequisite LCBSI criteria are met. MBI-LCBSI is a subset of LCBSI criteria.
MBI-LCBSI 1	Defined as patients of all ages identified by culture or non-culture microbiological testing of at least one blood sample, with intestinal organisms ONLY.
MBI-LCBSI 2	Patients of all ages with at least two matching blood samples with ONLY Viridans Group Streptococcus and/or Rothia spp. alone but no other organism
MBI-LCBSI 3	. Patients younger than 1 year old with at least two matching blood samples identified only for S. viridans and/or Rothia spp.

LCBSI: Laboratory Confirmed Bloodstream Infection; MBI-LCBSI: Laboratory Confirmed Bloodstream Infection with Mucosal Barrier Injury; BSI: Bloodstream Infection; CRI: Catheter-Related Infection; CRBSI: Catheter-Related Bloodstream Infection; NHSN: National Healthcare Safety Network; CVC: Central Venous Catheter; CVC-BSI: Central Venous Catheter-Related Bloodstream Infection; IWP: Infection Window Period; ED: Event Date.

The following terms and definitions (Table 1) contain critical information used in identifying, monitoring, and treating bloodstream infections.[6,7,11,25–27]

DEFINITION OF CONTAMINATION IN BLOOD CULTURES

Contamination refers to a situation that causes growth in culture results even though the organism in question can't be isolated from the blood sample. The majority of contamination cases occur as a result of microorganisms found in the skin flora contaminating blood culture bottles.

MISTAKES INCREASING BLOOD CULTURE CONTAMINATION

Inadequate skin antisepsis (lack of contact time or new contact), improper preparation of blood culture bottles (lack of cap disinfection), syringe needle exchange with multiple interventions, and blood collection from intravenous catheters (inoculation) errors often occur in the preanalytical process and increase the risk of contamination.

MICROBIOLOGICAL DEFINITION OF CONTAMINATION

Contamination is defined when one or more skin microbiota member microorganisms are found growing in only one of the patient's multiple blood

culture sets (e.g., in one or more bottles of one set, in one of two sets, in one of three sets). The patient should not have any clinical manifestations or microbiological evidence of infection with these microorganisms. In addition, the proliferation of bacteria native to the skin microbiota in the peripherally drawn blood culture when the intravascular catheter cultures are negative, or the differences in the isolated bacteria from each other when the intravascular catheter cultures and peripheral vein cultures are positive can be given as examples of contamination.

DIFFERENTIATION OF CAUSATIVE AGENTS AND CONTAMINATION IN BLOOD CULTURES

To differentiate between the agent and contamination, the same agent must be isolated in blood cultures taken from at least two separate veins (if species-level identification and antimicrobial sensitivity are the same). When a possible contaminant is detected in the first blood culture, the isolate is best retained until the outcomes of other blood cultures are obtained. If other blood cultures produce the same agent, they should be regarded as causative and reported. However, if the identification or susceptibility results are different, the isolated bacteria should be considered contaminants. In the case of growth of important microorganisms (e.g., C. albicans, group A streptococci, and Gram-negative bacilli), these elements ought to be considered, even when the colony count is <15 cfu.

CONTAMINATION RATES AND IMPORTANT MICROORGANISMS

Contamination is detected in approximately one-third of positive blood cultures. Decreasing the amount of blood taken heightens the risk of contamination. Additionally, aside from the skin microbiota, some microorganisms that can temporarily colonise (Acinetobacter spp., C. perfringens, etc.) may cause contamination in blood cultures if appropriate skin antisepsis is not performed. Members of the skin microbiota considered to be contaminated include coagulase-negative staphylococci (CoNS), Corynebacterium species (except C. jeikeium), Bacillus species (except B. anthracis), Micrococcus species, Aerococcus species, and Cutibacterium species.[11,22–26]

CATHETER AND BLOOD CULTURES IN DIAGNOSIS

Once adequate skin preparation has been performed, paired samples from the catheter and a peripheral vein should be acquired for culturing before starting antibiotics. Diagnostic testing for vascular catheter-associated infection should not be performed without a high suspicion of CRBSI. However, it may be recommended that patients without CRSBI undergo screening tests every 3 months if their risk of CRBSI is high.

In general, the most precise approach for diagnosing CRBSI is quantitative blood cultures. For CRI, catheter culture, peripheral blood culture, differential time (DT) when the catheter is preserved, cast plate, catheter tip culture when the catheter is removed, and if the port is removed (port reservoir content as well as the catheter tip) methods can be used.[28] A sample should be collected for Gram staining and culture when CRI is suspected, and exudate is noted at the catheter exit site. Studies show that the DT test has an overall sensitivity of 96.0% and is as high as 100% when there is no delay in collecting, transporting, and loading blood culture bottles into the analyzer. Delays in loading blood culture bottles (>4 hours) have a greater impact on reducing sensitivity than delays in collecting central and peripheral blood samples (>10 minutes).[28,29]

BLOOD CULTURE IN THE DIAGNOSIS OF FUNGI

Laboratory practices required for blood culture collection and processing are similar for cases with bacteremia and candidemia. The sensitivity of blood culture in diagnosing candidemia is 50-75%. Therefore, if candidemia is suspected and no mycotic growth can be noted in the blood cultures, auxiliary diagnostic tests should be used. Generally, for mycotic blood culture bottles, the time needed is at least three weeks.

RAPID ANTIMICROBIAL SUSCEPTIBILITY TESTING FROM BLOOD CULTURE BOTTLES

A further period of 24-48 hours is required for passages from blood culture bottles following the growth signal and for antimicrobial susceptibility testing (AST) by traditional definition. Disc diffusion test is a standardised, easy-to-apply, cheap, repeatable and reliable test that does not demand additional devices and equipment to obtain AST results in all medical microbiology laboratories. On the other hand, with EUCAST-HADT, results are obtained in 8 hours. This is imperative for the early intervention of patients in critical condition.[22–24,28]

INCONSISTENT RESULTS

If the initial culture signal is positive and no growth occurs in the passage despite the Gram staining result being positive, anaerobic bacteria that grow poorly or slowly should be considered. If a positive signal is received, but the Gram staining is negative or no growth is noted in the passage, the breeding curve should be examined in detail using automated systems. If the growth curve shows microbial

growth, different staining methods, such as carbol fuchsin, Giemsa, acridine orange, can be used. This can also guide the selection of supplementary culture medium.[11,22–24]

CULTURING PROCEDURE

In adults, the optimal volume of blood to be collected for each blood culture set is 20-30 mL. The blood taken from the catheter and the periphery should be the same volume. The location (catheter/periphery) and the time of blood collection must be recorded on blood culture bottles. The standard incubation period in automated blood culture systems is five days. A blood culture set should contain one of each of the aerobic and anaerobic bottles (except for paediatric patients). Compared to sets containing only aerobic bottles, the use of sets containing both aerobic and anaerobic bottles enables the detection of obligate anaerobic bacteria and faster growth of some facultative anaerobic bacteria and C. glabrata.[11,22–24]

When performing more than two separate blood draws on the same or consecutive calendar days, separate field preparation or blood cultures should be assigned different numbers during blood or sample collection. These samples are processed separately and reported separately in the final laboratory report. Blood culture bottles should be delivered to the laboratory within two hours after blood collection and should be preserved at room temperature during transportation. Transfer of vials to the laboratory should be done using an appropriate method and transport container.[25]

CATHETER-RELATED BLOODSTREAM INFECTION DIAGNOSIS

Definitions of CRI vary across different sources, making comparison difficult. Standardised definitions for catheter-related infections have been offered by the Centers for Disease Control and Prevention National Healthcare Safety Network (NHSN), and the Infectious Disease Society of America (IDSA). While the NHSN definition for CRBSI is used for surveillance purposes, the IDSA criteria for CRBSI are used for narrower diagnostic purposes. In this review, definitions of catheter-related infections were evaluated and categorised as follows:

- Catheter-Associated Bacteraemia (CAB): Isolation of the same organism in semi-quantitative or quantitative cultures of blood drawn from a peripheral vein as well as the catheter lumen.
- Catheter-related bloodstream Infection (CRBSI): It is characterised as the same organism being isolated in semi-quantitative or quantitative cultures of blood taken from both the catheter lumen and the peripheral vein and the presence of clinical symptoms of bloodstream infection in the patient. It is considered to indicate CRBSI if the colony count of a blood sample taken from the catheter lumen numbers more than thrice the colonies compared to the blood taken from a peripheral vein or if the number of colonies of a blood sample taken from a lumen number more than thrice the colonies of a blood sample taken from the second lumen. According to the IDSA definition, quantitative blood cultures taken from the catheter and peripherally, where blood taken from the catheter produces 3 times more colonies than peripheral blood, and microbial growth in blood taken from a catheter can be identified at least 2 hours before microbial growth can be identified in blood samples taken from a peripheral vein best defines CRBSI.
-No criteria: A condition that does not fit a standard definition for CRI.[11,13,26,30,31]

DIAGNOSIS IN CASE OF CATHETER REMOVAL

When it is decided that the catheter needs to be removed, first, a pair of blood cultures should be taken from the catheter and the periphery. Additionally, the removed catheter should also be sent to the laboratory for culture. Catheter culture can be obtained in two ways:

1. Short-Term Catheters (less than 14 days): The "roll plate" method is advised for routine clinical microbiological analysis for the tip of such catheters. In this method, a 5 cm segment taken from the distal end of the catheter, removed aseptically, is rolled back and forth 4-5 times on a blood agar surface and sown. The fact that >15 cfu grew at the end of incubation and that the growing microorganism was similar to that in peripheral blood culture would indicate that the catheter is not the root of the bloodstream infection.
2. Long-Term Catheters (≥14 days duration): For these types of catheters, semiquantitative growth of the same microorganism from both insertion site and catheter hub cultures at <15 cfu/plate indicates that the catheter is not the root of the bloodstream infection. The most accurate diagnostic approaches for identifying microorganisms on both the interior and exterior of the catheter are quantitative catheter culture techniques (luminal washing or sonication procedures), which also have higher specificity than qualitative fluid cultures.

DIAGNOSIS OF CRBSI IN CATHETER PRESERVED CASES

In cases where automated blood culture systems are used: A minimum of two sets of blood cultures are obtained concurrently or consecutively, one sample collected from the peripherally and the other from the catheter lumen or port chamber. If the same type of microorganism is isolated from both sets with

identical AST results and there is no other focus of infection, CRBSI can be considered.[11,22–24,32–34]

Delays in confirmation of CRBSI can be solved by methods such as rapid gram or acridine staining of cultures[32]. Acridine orange leukocyte cytospin (AOLC) and PCR targeting bacterial 16S ribosomal DNA are other tests used in the diagnosis of CRI but are not routinely used in clinical microbiology laboratories.[9,35]

Antimicrobial coatings may cause false negative culture results. For catheters coated with silver sulfadiazine or chlorhexidine, particular inhibitors can nullify this drawback, whereas the same does not apply to catheters coated with minocycline or rifampin.

CATHETER-ASSOCIATED SKIN INFECTION

If sepsis is suspected at the skin entry point or tunnel of the catheter, external-hub swab culture and blood cultures are required. Positive results are important to determine the origin of CRI.

INTERPRETATION OF THE CRBSI DIAGNOSIS

The following criteria should be taken into consideration for the diagnosis of CRBSI:

- The first growth should be in the blood culture taken from the catheter.
- The difference between the positivity time of the blood culture taken from the periphery and the blood culture taken from the catheter should be at least 120 minutes.
- The difference between positivity times being less than 120 minutes does not exclude the diagnosis of CRBSI.
- If there is >100 cfu/mL bacterial or >25 cfu/mL fungal growth in the catheter blood, the diagnosis of CRBSI can be considered even if there is no growth in the blood culture taken from the periphery.
- When both blood cultures are negative, the diagnosis of CRBSI is not considered.[11,22–24,32]

DISCUSSION AND CONCLUSION

Catheter selection is very important to prevent catheter-related complications in patients undergoing HPN treatment. CRBSIs are associated with life-threatening complications, especially sepsis, septic shock, and metastatic infections. CRBSI definitions are important for both early diagnosis and catheter rescue approaches in these catheter-dependent patients. The definitions provide effectiveness in terms of both necessary and timely antibiotic use and cost, morbidity and mortality.

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