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Comparison of Two Needleless Connector in Preventing Catheter Related Sepsis Risk in Intensive Care Unit: Prospective Cohort Study

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Yoğun Bakım Ünitesinde Katetere Bağlı Sepsis Riskinin Önlenmesinde İki İğnesiz Konnektörün Karşılaştırılması: Prospektif Kohort Çalışması

ABSTRACT

Objective: *The primary purpose of this study is to compare two different needle-free connectors to show that when used correctly the needle-free connectors port does not cause pathogenic surface colonization. The secondary objective is to determine whether there is a difference in catheter or blood stream infection between two kind of needle-free connectors.*
Method: *Aged 18-99, 199 patients, who were inserted central venous catheters follwed-up in intensive care unit were included to the study. The patients were divided into two groups as Group A (n: 99) and Group B (n: 100) according to the needle-free connector type used. During this study manipulation number of devices will be reported. Two blood culture samples, one from the central venous catheter and the other from the peripheral vein, were taken from the patient before removing the catheters.*
Results: *There was no statistically significant difference between age, day of ICU stay, fever, number of medications, number of connector changes and length of longest connector stay. In Group A, 7 patients and In Group B, 23 patients had colonization in catheter culture and it was statistically significant. Colonization was detected 14 patients in Group A, and 28 patients in GroupB in blood culture, and it was statistically significant.*
Conclusion: *Hub contamination can lead to sepsis, which can lead to life-threatening consequences and suitable hub selection has an effect on sepsis control. Suitable needle-free connector selection has an effect on sepsis control. We thought that, Group A free connector is better at avoiding sepsis then other connector when standard disinfection technique is used.*

Keywords: *Needleless connector, catheter related sepsıs, ıntensıve care unit*

ÖZ

Amaç: *Bu çalışmanın temel amacı, doğru kullanıldığında iğnesiz bağlantı noktasının patojenik yüzey kolonizasyonuna neden olmadığını göstermek için iki farklı iğnesiz bağlantı noktasını karşılaştırmaktır. İkincil amaç, iki tür iğnesiz konektör arasında kateter veya kan akımı enfeksiyonunda bir fark olup olmadığını belirlemektir.*
Yöntem: *Yoğun bakım ünitesinde takip edilen santral venöz kateter yerleştirilen 18-99 yaş arası 199 hasta çalışmaya alındı. Kan kültürü olmayan olgular çalışma dışı bırakıldı. Hastalar kullanılan iğnesiz konektör tipine göre A Grubu (n: 99) ve B Grubu (n: 100) olarak iki gruba ayrıldı. Bu çalışma sırasında cihazların kullanma sayısı kaydedildi. Biri santral venöz kateterden diğeri periferik damardan olmak üzere 2 kan kültürü örneği, kateterleri çıkarmadan önce hastadan alındı.*
Bulgular: *Yaş, yoğun bakımda kalma günü, ateş, ilaç sayısı, konektör değişiklik sayısı ve en uzun konektör kalış süresi arasında istatistiksel olarak anlamlı bir fark yoktu. A Grubunda 7 hastada kateter kültüründe üreme oldu. B Grubunda ise 23 hastada kateter kültüründe üreme oldu ve istatistiksel olarak anlamlı bulundu. A Grubunda, kan kültüründe 14 olguda, B Grubu'nda 28 olguda üreme saptandı ve istatistiksel olarak anlamlı bulundu.*
Sonuç: *Konnektör kontaminasyonu, hayatı tehdit edici sonuçlara yol açabilen sepsise yol açabilir ve uygun konnektör seçiminin sepsis kontrolü üzerinde etkisi vardır. Uygun iğnesiz konektör seçimi sepsis kontrolü üzerinde bir etkiye sahiptir. Grup A iğnesiz konektör, standart dezenfeksiyon tekniği kullanıldığında sepsisin önlenmesinde diğer konektörlerden daha iyi olduğunu düşünmekteyiz.*

Anahtar kelimeler: *İğnesiz konektör, kateterle ilişkili sepsis, yoğun bakım ünitesi*

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INTRODICTION

Nowadays, central venous catheters, which have widespread usage, are used for the purpose of fluid replacement, administration of long-term total parenteral nutrition, transfusion of blood and blood products, drug applications, and venous sclerosing agents in patients requiring intensive treatment [(1)].

Centrally inserted catheters are applied to the subclavian vein, internal-external jugular vein, femoral vein and antecubital veins. Infection and thrombosis are the two most common complications associated with central catheters. Blood stream infections are a serious and increasing problem among nosocomial infections. Intravascular catheters are one of the most common causes of nosocomial bacteremia. Hospital costs, length of hospital stay, morbidity and mortality are increased by catheter infections [(2)].

In short-term catheters (≤8 days), the majority of infections originate from the site of catheter entry. It develops by surface colonization (commencing within 24 hours) of the insertion site and progression of colonized microorganisms along the outer surface of the catheter. Especially in catheters, the junction called hub is infected and may cause bacteremia. Other colonization sources in short-term catheters are catheter hub / lumen (10-50%), blood flow (3-10%, up to 50% in intensive care units), and infused fluids (2-3%). In long-term (> 8 days) catheters, the sources of colonization are often hub / lumen (66%) and skin (26%) [(3)].

Catheter infections are the result of interactions between the host, a foreign body, the catheter and the pathogenic microorganism. Inflammation occurs as a result of interaction between the host and the catheter. Various substances are released from the macrophages that come to this inflammation site (hydrolase, tumor necrosis factor, complement fragments, interleukins, prostaglandins, plasminogen activator, coagulation factors). In this interaction, the type of catheter (physical properties of the catheter surface, surface irregularities, charge differences), application site, hydrophobicity and bacterial properties are important, as well as the general condition of the host (underlying disease, burn, immune suppression) [(4)]. Proper use of needle-free connectors has reduced the risk of catheter-related infections in patients. When these devices are used on catheters, fever infections are expected than in unused cases [(1)].

The primary purpose of this study is to compare two different needle-free connectors to show that when used correctly the needle-free connectors port (silicon septum) does not cause pathogenic surface colonization. The secondary objective is to determine whether there is a difference in catheter or blood stream infection between two kind of needle-free connectors.

MATERIAL and METHODS

Setting

This prospective COHORT study was performed at a tertiary education and training hospital. The ethics committee (2018/05) approved this study.

Inclusion and exclusion criteria

Number of the patients included in this study is 199. Inclusion and exclusion criteria of the study were shown in Flow chart (Figure 1).

Patients were randomized into two groups: Group A: patients who were used FlowArt© needle-free connector (n:99), Group B: patients who were used another needle-free connector (n:100).

Cases without blood culture will be excluded from the study.

Study design

Needle-free connectors of two different brands were used during in-situ 168 hours on central venous catheters.

Materials used for administration of drugs or serum infusions to the connectors will be stingless, and there won't be any kind of penetrative attempts with penetrative or interruptive materials.

Before and after every manipulation of devices, %70 (v/v) isopropyl alcohol-soaked tissues will be used to disinfect the connections. The wipes will be applied firmly to the septum of the device and rotated 360 ° and applied for 15 seconds and allowed to dry for 20 seconds.

Irrigation will be made with 5 cc serum physiologic (SP) after every drug or serum administration, and

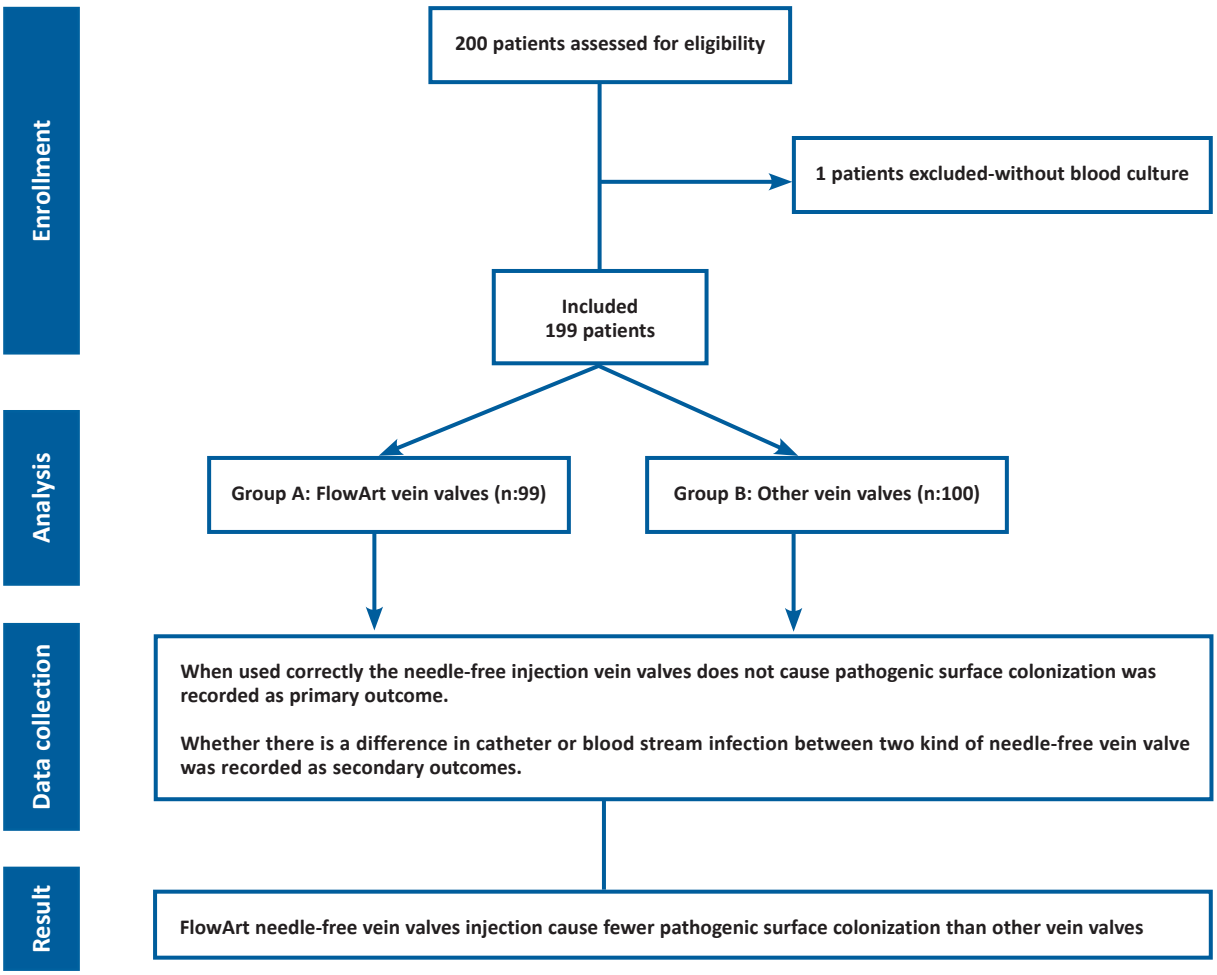

Figure 1. Flow diagram of the study.

surface of the connectors will be disinfected with antiseptic solution after removal of the injector.

During this study manipulation number of devices will be reported.

2 blood culture samples, one from central venous catheter and the other from peripheral vein, will be obtained from the patient before removing the catheters who doesn't require catheter anymore.

The catheters will then be disinfected with polyvinyl pyrrolidine iodine and removed.

For every patient, duration of the in situ intravenous access will be reported.

All samples will be placed into a sterile container and transported to the microbiology laboratory for incubation.

In case there is not any colonization in semiquantitative culture of catheters tip and in haemoculture or in case of colonization of same microorganism in both haemoculture (central and peripheral venous catheters) and when clinically there isn't a suspect about catheter related infection, catheter will be considered as sterile.

Statistical Analysis

Firstly, the descriptive properties of the variables (median, and range) were found. Numerical variables were checked for normal distribution. Mann-Whitney U test was used for non-normally distributed numerical variables. Chi-square test and Fisher exact test were used to compare categorical variables.

p <0.05 was considered statistically significant. SPSS 15 program (Chicago, USA) was used to evaluate the results.

RESULTS

Group A: FlowArt© needle-free connector (n:99), Group B: another needle-free connector (n:100). Mean age of patients was in Group A: 62 (46-79) and in Group B: 65 (47-80).

There was no statistically significant difference between age, day of ICU stay, fever, number of medications, number of connector changes and length of longest connector stay (Table 1).

In Group A, 7 patients had catheter culture colonization. In Group B, 23 patients had the catheter culture colonization and it was statistically significant (p=0.001) (Table 2).

In Group A, 14 patients had blood culture colonization. In Group B, 28 patients had blood culture colonization (p=0.02) (Table 2).

Comparison of microorganisms in blood and catheter cultures are given in Tables 3 and 4.

Table 4. Comparison of microorganisms in catheter culture.

Positive colonization in cultures	Group A (n=99)	Group B (n=100)	p
Acinetobacter baummani	2	**12**	0.01
Pseudomonas aeroginosa	2	**1**	1.00
MRSA	0	**1**	1.00
Klebsiella pneumonia	0	**1**	1.00
Candida types	0	**1**	1.00
Corybacteria	0	**1**	1.00
Enterococus	0	**2**	0.49
Staphylococcus types	3	**4**	1.00

DISCUSSION

Pathogens can produce catheter-related sepsis (CRS) in different ways, such as contaminated intravenous fluids, bacteremia and fungemia from a distant site of infection, catheter insertion site and catheter hub. A catheter and hub require intraluminal protection as well as extraluminal site management. To obtain reliable patient outcomes, flushing and swabbing procedures should also be clinically studied for individualized to the patient's specific infection condition [5,6].

Intraluminal catheter colonization remains a significant mechanism for central venous catheters (CVCs) blood stream infections in adults requiring prolonged

Table 1. Comparison of statistical information about the use of connector.

Mean	Group A (n=99)	Group B (n=100)	p
Age	62 (46-79)	65 (47-80)	0.44
Length of use (days)	10 (5-19)	10 (5-18)	0.99
Fever min ºC	36.5 (36.3-36.6)	36.5 (36.4-36.7)	0.20
Fever max ºC	37 (36.8-37.6)	37 (36.9-37.5)	0.46
Total number of injections	34 (22-47)	38 (21-59)	0.34
Number of connector changes	1 (0-2)	1 (0-2)	0.51
Longest use of connector	5 (3-7)	6 (3-9)	0.10

Table 2. Comparison of culture colonization.

Positive colonization in cultures	Group A (n=99)	Group B (n=100)	p
Sputum Culture	14	**24**	0.23
Urine Culture	12	**25**	0.04
Blood Culture	14	**28**	0.03
Catheter Culture	5	**23**	0.001

Table 3. Comparison of microorganisms in blood culture.

Positive colonization in cultures	Group A (n=99)	Group B (n=100)	p
Acinetobacter baummani	4	**8**	0.38
Pseudomonas aeroginosa	1	**1**	1.00
MRSA	1	**1**	1.00
Coagulase negative *Staphylococcus*	1	**1**	1.00
Candida types	1	**6**	0.11
Enterobacter types	0	**1**	1.00
Klebsiella pneumonia	0	**0**	1.00
Enterococus	0	**3**	0.24
Staphylococcus types	11	**7**	0.93

CVCs [7,8]. Colonization of bacteria on cultures from needle-free hub connectors has been associated with an increased risk of central line-associated blood stream infections [9]. Other studies suggest needle-free hubs may protect against CVC colonization and may thus prevent central line-associated blood stream infections [10]. In our study, before and after every manipulation of devices, 70% isopropyl alcohol tissues were used to disinfect the connections. In our study, in Group A, 7 patients and In Group B, 23 patients had colonization in the catheter culture. In Group A, 14 patients, and 28 patients in Group B had colonization in the blood culture. This is consistent with our findings as the group B catheter tip cultures were found to have higher colony forming bacteria (CFU) then the group A catheter tip cultures.

In this present study, we investigated whether two different I.V. connectors would make a difference in the colonization of the catheter tip or blood culture. We found that there was significantly less growth in catheter tip or blood culture in I.V. connectors in Group A. Studies have shown that different I.V connectors have different effects on infection [11].

All catheter tips and blood from all CVCs were cultured in this study. There was no statistically significant difference between age, day of ICU stay, fever, number of medications, number of connector changes and day of longest connector stay.

Catheter hub has been implicated as an additional entry point leading to CRS [12]. When the hub is contaminated, pathogens colonize and pass through the catheter, causing sepsis. Consequently, if catheter tip growth and blood culture growth have the same result, hub contamination may play an important role in the development of sepsis. This suggests that sepsis develops secondary to hub contamination.

In conclusion, hub contamination can lead to sepsis, which can lead to life-threatening consequences and suitable hub selection has an effect on sepsis control. We showed that suitable needle-free connector selection has an effect on sepsis control. FlowArt neddle free connector is better at avoiding sepsis then other connector when proper disinfection technique is used. Always take precautions before the problem occurs to protect against greater damage.

Ethics Committee Approval: İstanbul S.B.Ü. Approval was received from the Kanuni Sultan Süleyman Training and Research Hospital Clinical Research Ethics Committee (2018/05 - 2089).
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