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The importance of arteriovenous fistula assepsia in hemodialysis center: An ilustrative case of endocarditis

João Grilo[1*]; Teófilo Yan[1]; Joana Coutinho[2]; Raquel Chorão[2]; Catarina Reis Santos[2]; Rui Alves Filipe[2] and Ernesto Rocha[3]

[1]Nephrology Resident, Hospital Amato Lusitano - Castelo Branco, Portugal.

[2]Nephrology Assistant, Hospital Amato Lusitano - Castelo Branco, Portugal.

[3]Nephrology Assistant and chief of nephrology department, Hospital Amato Lusitano - Castelo Branco, Portugal.

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***Corresponding Author:** João Pedro Loureiro de Almeida Grilo, Nephrology Resident, Hospital Amato Lusitano - Castelo Branco, Portugal.
Email: joao_grilo93@hotmail.com

Abstract

Hemodialysis (HD) is currently the most widely used renal replacement therapy for end-stage chronic renal disease. Native arteriovenous fistula (AVF) is the preferred access because of lower infectious and thrombotic risk, higher survival, shorter hospitalization time, lower mortality and associated morbidity. However, the risk of AVF infection, namely by methicillin-resistant staphylococcus aureus (MRSA), should not be underestimated, especially when using the Buttonhole technique in which cannulation of the AVF is performed in exactly the same place in every dialysis session. We present an uncommon case of endocarditis with metastatic complications (multifocal septic arthritis, multiple pulmonary cavitations and disseminated purpuric rash), associated with presumed access-related S. aureus bacteremia in a patient undergoing regular HD program with an AVF cannulated with the buttonhole technique, with a surprising complete resolution of tricuspid valvular vegetation and all other secondary infections with 8 weeks of antibiotherapy.

Keywords: Infective Endocarditis; Arteriovenous fistula; Buttonhole technique.

Abbreviation

HD: Hemodialysis; AVF: Arteriovenous fistula; MRSA: Methicillin-resistant staphylococcus aureus; CRP: C-reactive protein; AST: Aspartate transaminase; ALT: Alanine transaminase; GGT: Gamma-Glutamyl Transferase; HCAE: Healthcare-associated endocarditis.

Introduction

Hemodialysis (HD) is currently the most widely used renal replacement therapy for end-stage chronic renal disease [1]. Arteriovenous fistula (AVF) is the preferred access because of lower infectious and thrombotic risk [2, 3], higher survival, shorter hospitalization time, lower mortality and associated morbidity. The risk of AVF infection, namely by methicillin-resistant staphylococcus aureus (MRSA), should not be underestimated. Currently S. aureus is known to be responsible for increased morbidity, mortality [4] and hospitalization in hemodialysis patients, associated with increased incidence of metastatic infections secondary to sepsis, such as infective endocarditis, osteomyelitis and septic arthritis [5]. We present an uncommon case of endocarditis, associated with presumed access-related S. aureus bacteremia in a patient undergoing regular HD program with an AVF cannulated with the buttonhole technique.

Case Presentation

We describe a case of a 70-year-old man with end-stage renal disease on regular HD program who presented to the emergency department for abdominal pain on the 6th of February 2020. The patient had a right radiocephalic AVF and was on hemodialysis for 3 years. He had a relevant history of open right hemicolectomy due to ascending colon neoplasia, T4N1M0 according to TMN staging system, with regular follow up by surgical oncology and no signs of relapse. The patient did not have any congenital or acquired heart disease. The patient was admitted to the surgical emergency with abdominal pain (6/10 on Stanford pain scale), which was characterized as constant, predominantly on the upper quadrants, anorexia and asthenia. The symptoms had started 5 days earlier and were gradually worsening. On physical examination the patient was noted to be pale, sudoretic, anicteric, febrile, 39ºC, normotensive and tachycardic. The abdomen was slightly distended,

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tender on light palpation of upper quadrants and epigastric region but no guarding, rebound tenderness or masses were found.

Blood work and abdominal ultrasound were performed. On blood work he had leukocytosis (13 x 10^3 /µL) with neutrophilia (10.51 x 10^3 /µL), thrombocytopenia (48 000 platelets), marked elevation of C-reactive protein (CRP) 424.5 mg/L, aspartate transaminase (AST): 38 U/L, alanine transaminase (ALT): 45 U/L, Alkaline phosphatase (ALP): 160 U/L, gamma-Glutamyl Transferase (GGT): 155 U/L and hyperbilirubinemia (3.55 mg/dL) mostly due to conjugated bilirubin (2.93 mg/dL). Abdominal ultrasound excluded acute surgical emergencies. The surgical team decided to admit the patient to general surgery department, started the patient on piperacillin-tazobactam empirically placing the diagnostic hypothesis of acute cholangitis and ordered complementary studies. On the third day of hospitalization the patient got worse maintaining the fever and abdominal pain despite no alarming sign or symptom on physical examination. On blood work he had worsening hematological and hepatic dysfunction and he had performed a computer tomography that was suggestive of a subpleural wedge-shaped consolidation on the right middle lobe and complicated renal cyst suggestive on infection (**Figure 1**).

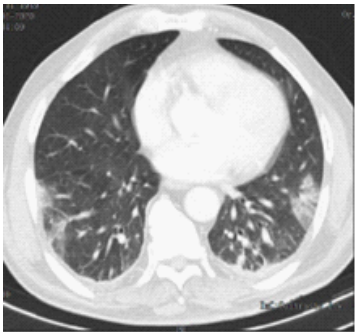

Figure 1: *Thoracic-Abdominal-Pelvic CT. Subpleural wedge-shaped consolidation on the right middle lobe.*

At this point collaboration of the nephrology department was requested. The nephrologist noted the patient's AVF which puncture technique was Buttonhole had light redness and heat near the site of proximal puncture (**Figure 2**).

Figure 2: *The patient's AVF had light redness and heat near the site of proximal puncture. On this image the AVF is being punctured distant from the buttonhole site.*

On physical examination there were no remarkable other signs or symptoms at this point. Blood cultures were ordered, a diagnosis of vascular access-related sepsis was assumed and antibiotics were changed. Broad spectrum antibiotics with gram positive coverage were initiated: vancomycin (1 gr after each HD session) and netilmycin (load dose of 300 mg, followed by 150 mg after HD session) and more complementary studies were ordered. The cannulation technique was changed and orders were given for cannulation site to change each dialysis session. In the following days, there was clinical improvement, however the patient remained subfebrile, was feeling very tired and weak and a painless purpuric rash started to develop on the upper limbs spreading to trunk and lower limbs in a few days (**Figure 3**). Simultaneously the patient started to complain of right knee and right clavicle pain, both of which had frank inflammatory signs.

Figure 3: *Painless purpuric rash on the upper limbs spreading to trunk and lower limbs in a few days.*

Transthoracic echocardiography showed a large vegetation with about 6 cm2 adherent to the tricuspid valve (Figure 4) causing only slight valve regurgitation. Repeated thoracic computer tomography revealed massive septic embolization with multiple cavitations affecting all lobes (Figure 5) and right sternoclavicular septic arthritis. Repeated blood cultures were negative.

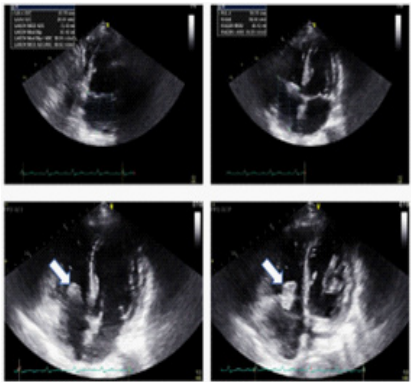

Figure 4: *Transthoracic echocardiography. A large vegetation with about 6 cm2 adherent to the tricuspid valve causing only slight valve regurgitation.*

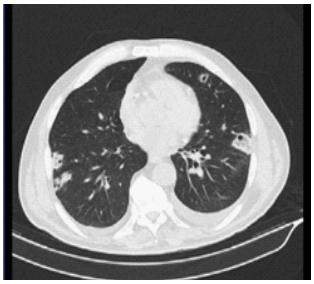

Figure 5: *Repeated thoracic computer tomography. Multiple septic embolization with cavitations affecting all lobes and right sternoclavicular septic arthritis.*

Antibiotic spectrum at this point was broadened for better bone/ articular coverage with the addition of ceftazidime 2g at the end of every HD session. Collaboration was requested to cardiothoracic surgery department, which suggested maintaining antibiotic therapy for at least two weeks to control the infection, performing cardiac catheterization to evaluate heart function and active vigilance of cardiac failure symptoms, in which case an earlier surgical approach should be preferred. Cardiac catheterism showed good heart function and no signs of coronary artery disease. Gradually over the next 2-weeks period there was significant clinical improvement with resolution of the purpura however with only a slight decreasing slope of C-reactive protein and a patient that remained subfebril (37.5-37.8ºC). The patient was evaluated at cardiothoracic surgery department on the 17th day of broad spectrum antibiotics and transesophageal echocardiography documented complete resolution of the tricuspid valve vegetation. It was assumed that maintenance of elevated inflammatory parameters was due to the other metastatic complications from sepsis and antibiotics were maintained.

On the 30th day of broad spectrum antibiotics the patient was afebrile, had significant clinical improvement of inflammatory signs of the joints (right knee and right sternoclavicular joint) and had recovered from the tiredness and anorexia. Blood work showed improvement of all parameters. Repeated thoracic CT revealed resorption of almost all peripheral cavitations. The patient was discharged from hospital with an indication to continue antibiotics intravenously every dialysis session to complete 8 weeks of antibiotics.

Discussion

We presented a case of a severe metastatic infection secondary to vascular-access bacteremia in a patient undergoing regular HD program. Our case report describes an unusual and complex case of vascular-access bacteremia providing instructive measures on how to prevent such complications in current clinical practice.

Healthcare-associated endocarditis (HCAE) arises primarily as a consequence of invasive treatments, including HD [6]. In a recent prospective study that included over 1600 patients with native valve endocarditis and no history of intravenous drug abuse, more than one-third of patients had HCAE, many acquiring it in the community, particularly in outpatient HD units. HCAE has assumed an increasing relevance with S. Aureus emerging as the most prevalent microorganism and classic Streptococcus of the viridans group prevalence decreasing in industrialized countries. Although some cases of infective endocarditis have a rapidly progressive clinical course over a matter of days, in others, such as HCAE, the evolution may be more insidious and the symptoms unspecific, requiring a high degree of suspicion for diagnosis [7].

In our clinical case, the initial symptoms pointed to an abdominal condition and the patient was admitted to the general surgery department. The lack of evaluation of AVF as well as the collection of blood cultures at an early stage delayed the diagnosis. In the majority of patients with infective endocarditis and who did not initiate antibiotherapy, blood cultures are positive, since the bacteremia of endocarditis is continuous. Blood cultures are truly negative in less than 5% of cases [7]. The initiation of antibiotherapy with Piperacillin-Tazobactam before the collection of blood for blood cultures, possibly resulted in their negativity. In hemodialysis subgroup of patients there is an increased incidence of involvement of the right heart chambers, particularly the tricuspid valve, as in intravenous drug users. This explains the pulmonary septic embolization observed in this case. The painless purpuric rash, although proeminent sign of bacterial endocarditis remains a rare occurrence nowadays and is mostly associated to Staphylococcus or Streptococcus species bacteremia.

Regarding the empirical antibiotherapy used in cases of vascular access related sepsis our department has routinely recommended the institution of triple antibiotherapy: vancomycin, netilmycin and ceftazidime. In this case, the introduction of ceftazidime could have been performed in a faster way, not being necessary the diagnosis of septic bone complications, such as osteomyelitis, for its inclusion in the therapeutic scheme.

In patients undergoing HD programs, the risk of infection in patients with AVF is known to be lower, compared to other vascular access options. However, the risk of infection of an AVF should not be neglected, especially when using the Buttonhole technique in which cannulation of the AVF is performed in exactly the same place in every dialysis session. Lately the buttonhole cannulation technique has been questioned with increasing studies showing a much higher access-related bacteremia compared to other cannulation techniques [8].

Aseptic measures are essential when handling AVF during HD sessions. First step involves washing hands and arms following basic sanitizing rules before stepping into the hemodialysis room and it is best performed by the patient himself. At our hemodialysis center the patient is taught to handwash by himself and taking care of his vascular access. Once the patient is ready for his HD session, the HD nurse should proceed with identifying puncture sites and washing the vascular access with an antiseptic solution in accordance with the local proceedings, clean with a circular movement or in a single direction from the insertion point outwards or through friction movements (mechanical action), in an area of 2 to 7 cm. Never pass the gauze compress over the area already cleaned and respect the time of action of the antiseptic solution used. If the buttonhole technique is used, after the previously described procedure, remove the crust and perform again the antisepsis of the cannulation site [9].

Authors' contributions

JG – Drafted the manuscript and was responsible for all data acquisition and data analysis.

TY – Contributed to the diagnosis and follow up of the patient. Made substantial contributions to the conception of the report.

JC – Contributed to the critical review of the manuscript from nephrology point of view.

CRS and RC- Were an essential part in multidisciplinary discussion that allowed for the final outcome of the case. Encouraged main author for publication of this case report contributing to conception and design.

RAF – Coordinated revisions from other authors.

EFR - Contributed to the follow up of the patient and gave the

final approval

of the version to be published.

All authors have read and approved of the manuscript to be submitted.

Ethics approval and consent to participate: Ethical committee approval was not needed as article case doesn't include research. Written consent from the patient was obtained for all procedures.

Consent for publication: Written informed consent for publication of their clinical details and images was obtained from the patient.

Competing interests: The authors declare that they have no competing interests.

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