VASCULAR ACCESS FAILURE - CAUSE OR COMPLICATION OF CENTRAL VENOUS CATHETERIZATION: CASE REPORT

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NEUSPEŠNOST VASKULARNE KATETERIZACIJE - UZROK KOMPLIKACIJE CENTRALNE VENSKE KATETERIZACIJE: PRIKAZ SLUČAJA

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ABSTRACT

The quality of life and patient survival rate in terminal chronic renal insufficiency depends on the duration of vascular approaches. Dialysis catheters are used to establish an adequate vascular approach when emergency hemodialysis is indicated and when all approaches are exhausted. Complications of CVC can be classified into three categories: mechanical (hematoma, arterial puncture, pneumothorax, hemothorax, catheter misplacement, and stenosis), infectious (insertion site infection, CVC colonization, and bloodstream infection) and thrombotic (deep vein thrombosis). Despite the increasing prevalence of haemodialysis patients with complex access issues, there remains no consensus on the definition of vascular access failure or end-stage vascular access. The dilema in these cases remains whether the generalized vascular insufficiency is the cause or a complication of exhausted vascular accesses. This case report is one of the examples of combined complications with generalized vascular access insufficiency. During the year and a half of the chronic dialysis program, the patient had several changes of vascular approaches, and each approach became dysfunctional in certain time due to various causes. After six months of successful hemodialysis, the patient was admitted with signs of infection and during hospitalization was again subjected to multiple changes of the vascular approach due to infection, thrombosis, and vascular access failure.

Keywords: *central venous catheter, infection, thrombosis, vascular failure*

SAŽETAK

Kvalitet života pacijenata sa terminalnom hroničnom bubrežnom insuficijencijom zavisi od trajanja vaskularnih pristupa. Dijalizni kateteri koriste se za uspostavljanje adekvatnog vaskularnog pristupa u slučajevima kada je indikovana hitna hemodijaliza i kada su svi drugi pristupi iscrpljeni. Komplikacije postavljanja centralnih venskih katetera se mogu grubo podeliti u tri kategorije: mehaničke (hematom, oštećenje arterije, pneumotoraks, hemotoraks, pogrešno postavljen kateter i stenoza), infektivne (infekcija mesta uboda, kolonizacija centralnog venskog katetera, sepsa) i trombotske (duboka venska tromboza, insuficijencija krvnih sudova, embolija). Jedna od ređih komplikacija je generalizovana slabost venskog sistema. Iako je učestalost pacijenata sa kompleksnim vaskularnim pristupima usled slabosti krvnih sudova u porastu ne postoji konsenzusna definicija ili podela insuficijencije vaskularnih pristupa (krajnji vaskularni pristup). Jedna od dilema u ovakvim slučajevima je utvrđivanje da li je generalizovana insuficijencija venskog sistema uzrok ili komplikacija iscrpljenih vaskularnih pristupa. Ovaj prikaz slučaja predstavlja jedan od primera kombinovanih komplikacija uz generalizovanu insuficijenciju vaskularnih pristupa. Kod opisane pacijentkinje je tokom godinu i po dana hroničnog dijaliznog programa promenjeno nekoliko vaskularnih pristupa za dijalizu, od kojih je svaki nakon izvesnog vremena postao disfunkcionalan usled različitih uzroka. Nakon šest meseci uspešne hemodijalize pacijentkinja je primljena zbog znakova infekcije i tokom hospitalizacije ponovo biva podvrgnuta višestrukim promenama vaskularnog pristupa zbog infekcije, tromboze, i insuficijencije vaskularnih pristupa.

Ključne reči: *centralni venski kateter, infekcija, tromboza, generalizovana vaskularna insuficijencija*

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INTRODUCTION

Dialysis patients are able to survive longer due to advances in nephrological care leaving those who are not fortunate enough to receive a transplant on long-term dialysis. In most cases of prolonged renal impairment, haemodialysis is the main treatment modality (1).

The quality of life and patient survival rate in terminal chronic renal insufficiency depends on the duration of vascular approaches. Since arteriovenous fistula (AVF) has the highest survival rate and the least complications, it should be a primary vascular approach whenever it is possible. Despite the priority of AVF, in almost 80% of patients with the indication for chronic dyalisis, a treatment starts with dyalisis catheter: temporary or permanent (2).

Dialysis catheters are used to establish an adequate vascular approach when emergency hemodialysis is indicated and when all approaches are exhausted. Although catheter placement provides a vascular approach, there is a possibility of reporting a number of complications: generalized infections, endocarditis, thrombophlebitis, blood vessel stenosis, vascular weakness, pneumothorax (3).

Catheter infections cause significant morbidity and increase patient mortality rate by more than 50% compared to patients with native AVF (3).

Central venous catheters are used as a permanent solution in patients with inability to make new vascular approaches or with contraindications for such solutions (AV fistula), as well as in elderly patients with poor prognosis. The most common CVC insertion sites are the right internal jugular vein or the right or left subclavian vein, while the left internal jugular vein is used less often because of the proximity of the ductus thoracicus and a possible damage to it (4).

CASE

A female patient aged 65 years was admitted to the Center for nephrology and Dialysis, Clinical Center Kragujevac due to general weaknes, fatigue, shivering and dysfunctional Hickmann catheter, with moderate bleeding in the area of catheter. Several latest hemodyalisis were difficult due to technical dysfunction of Hickmann catheter. At the admission the patient was aware, oriented in all three directions, afebrile, eupnoic, with the aspect characteristic for patients with renal dysfunction, turgor was weakened. On physical examination: Thorax was symmetrically respiratory mobile, with Hickmann catheter in the area of right subclavian artery; postoperative scar in the right lumbal area with hernia after nephrectomy. Respiratory function and heart beat were normal; BP: 100/60 mmHg.

The patient was on a chronic hemodyalisis programe (3x4 hours) for a year and a half as a treatment method for terminal renal dysfunction due to renal calculosis. She had a right-sided nephrectomy after prerenal absces a year ago. First temporary dyalisis was made through the placement of central venous catheter in right internal jugular vein. For the first three months the patient was on a chronic hemodyalisis through AV fistula, created on the distal part of the left forearm, which became thrombotic after few months. Following that, the patient had another dysfunctional AV fistula. Six months ago central venous catheter for hemodyalisis was placed in the left jugular vein and subsequently, due to catheter dysfunction, another catheter in left femoral vein. Due to exhausted vascular approaches, peritoneal dialysis was used, but the patient had recurrent peritonitis so the application of permanent catheter (Hickman) in the right subclavian vein was made.

After six months of successful hemodyalisis, the patient was addmited with lumbal pain and signs of inflamation: procalcitonin: 3.17 ng/mL (normal values 0.5-2 ng/mL), white blood cells (WBC): 15.9 x 10^9/L (normal values 4-10 x 10^9/L) and C-reactive protein (CRP): 178.7 mg/L (normal values <5 mg/L). Sympthomatic and empiric therapy with i.v Vankomycin 20 mg/kg was started during the last dyalisis for 5 days. Negative Staphylococcus coagulase was isolated from hemoculture and a clinical pharmacologist was consulted for the further therapeutic approach. Since the patient is allergic to Ceftriaxone and Amoxicillin with Clavulanic acid, a therapy with Vankomycin was continued, which reduced inflammatory markers after a few days: WBC: 5.6x10^9/L, CRP: 132 mg/L, PCT: 1.92 ng/mL.

Hematologist was also consulted, because the dialysis catheter (Hickman) was often obstructed by coagulum. After the placement of CVC both arms of catheter were heparinised according to the protocol several times, but obstructions were quickly re-established. The repositioning and purification of Hickman's hemodialysis catheter (Figure 1) was done under aseptic conditions, and the reposition was done because it was not functional. In the same act, the actilisation was applied to both arms in order to break the thrombus into the lumen of the catheter. After the action of the drug and the purification of the catheter, it became functional again.

After initial improvement, the patient developed repeated signs of infection and a new obstruction of Hickman's catheter after several days. Given that all possible approaches to placing CVC have become dysfunctional and difficult to obtain by regular placement techniques, presumeably due to general weakness of blood vessels, we have opted for ultrasound-guided CVC application. This method enabled us to locate the right jugular vein and open a new approach, after which the patient was stabilized (Figure 2A/B).

DISSCUSION

A critical factor in the outcome for haemodialysis patients is definitive vascular access either in the form of an arteriovenous fistula (AVF) or an arteriovenous graft (AVG). Autologous AVFs are a preferred choice for supe-

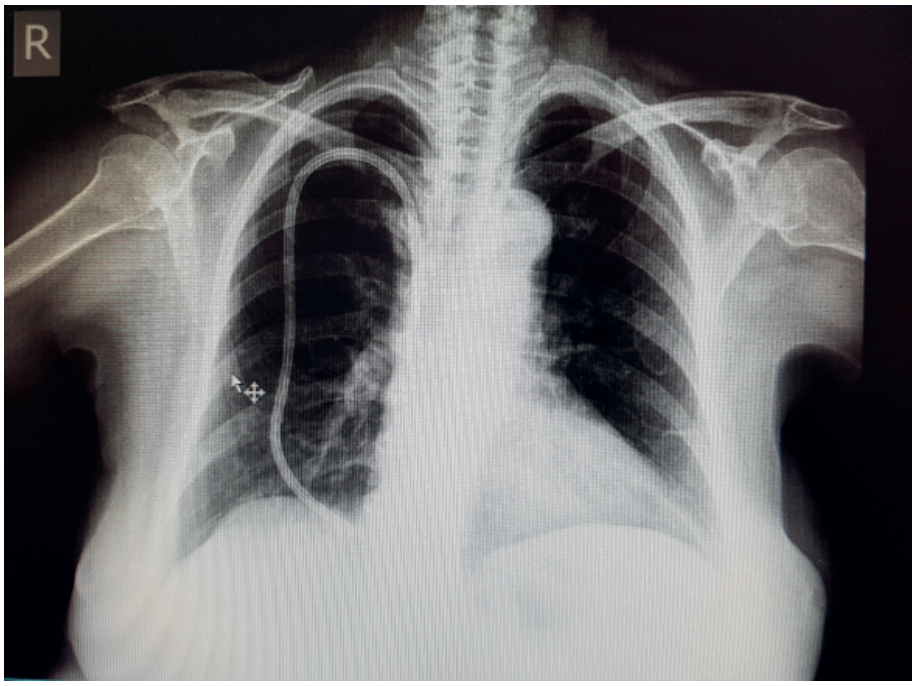

Figure 1.

rior long-term outcomes, better infection resistance and fewer interventions. Central venous catheters (CVC) in contrast have poor patency, higher infection rates and are associated with complications including central venous stenosis (5,6). With our patient, the protocol for dyalisis was followed since her first permanent vascular access was done through AVF, but since this approach was several times dysfunctional, patient was transfered onto CVC approach for dyalisis. This, however, was also followed by numerous complications: often thromboses, infections, vascular insufficiency, causing the exhaustion of vascular accesses.

Complications of CVC can be classified into three categories: mechanical (hematoma, arterial puncture, pneumothorax, hemothorax, catheter misplacement, and stenosis), infectious (insertion site infection, CVC colonization, and bloodstream infection) and thrombotic (deep vein thrombosis). These three categories occur in 5%–19%, 5%–26% and 2%–26% of patients, respectively (7). Our patient often had infectious and mechanical complications

Figure 2A.

Figure 2B.

before the current hospitalisation. Complications associated with CVC insertion range from 5% to 19% (8). They can be distinguished as insertion and indwelling complications. The insertion complications are vascular injury (arterial puncture, pseudoaneurysm, arteriovenous fistula), hematoma, air embolism, pneumothorax and malposition. Indwelling complications are infection, thrombosis, catheter pinching/kinking and fracture with possible embolization (9).

Infection of CVC leads to increased morbidity and costs in health-care systems. Femoral access has been shown to be associated with an increased risk of infection, but some authors suggest that there is no difference among the three puncture sites when the strict sterile technique is followed (10). As for our patient, the occurence of infections was not associated with a specific CVC placement site, since she had prehosital infection associated with all three approaches: femoral, jugular and subclavian.

Microorganisms that most often colonize CVC are cogulase-negative Staphylococcus, Staphylococcus aureus, Gramm-negative microorganisms and Candida spp. (11). Hemoculture showed a presence of cogulase-negative Staphylococcus as a cause of inhospital infection in our patient, which confirmed above mentioned statement on incidence of antimicrobial agents.

For short-term use, the subclavian veins have been reported to be associated with lower incidence of associated infection than the internal jugular or femoral veins. However, according to a recent meta-analysis, there is no difference in the incidence of catheter-associated bloodborne infection between those three sites of vascular access, probably as a result of the implementation of new procedures and techniques for prevention (evidence level 1b) (12).

Fibrin sheaths, that cause catheter malfunctions, begin to format the catheter entry site into the vessel as an inflammatory response to the presence of a foreign body. In time, 100% of fibrin sheaths are colonized with bacteria (7). Both thrombosis and infection were often found in our patient, which was causing catheter malfunctions and need for a new approaches.

Thrombosis causing catheter malfunction can occur either within the catheter lumen or within the vessel lumen. A prevention of thrombosis is usually achieved by filling the lumen of the catheter with an anticoagulant (heparin or citrate) with or without antibiotic. Intravascular thrombosis is usually asymptomatic and only manifests itself with catheter malfunction (7). Our patient was treated with antibiotic therapy (Vankomycin) since the begining of hospitalization. Although she was treated with antibiotics and had an initial improvement, she had a reinfection and signs of sepsis, probably due to antibiotic resistence of infectious agent. In consultation with hematologist we made additional analyses for discovering the cause of reoccuring thrombosis which was causing the malfunction.

The preferred site for catheter placement is the right internal jugular vein, low in the neck and close to the jugular bulb so that there is little chance for catheter kink when tunneling to the chest wall. When the right vein is occluded, the right external jugular vein should be used before attempting access on the left side. The left internal jugular vein is the third choice, and is a technically challenging approach owing to the tortuous course from the left vein to the superior vena cava. Once the internal and external vein are exhausted in patients, other alternatives can be entertained, such as subclavian veins (13). In our patients all of the approaches were exhausted due to often infections, thrombotic occlusions and vascular insufficiency. Since there was a difficulty with replacing the CVC in new place we decided to use ultrasound-guided technique which helped us establish a new and secure approach.

Despite the increasing prevalence of haemodialysis patients with complex access issues, there remains no consensus on the definition of vascular access failure or end-stage vascular access. A group of authors tried to define a classification system-based anatomically to reflect the degree of severity of access failure. They have defined end-stage access failure as occurring when bilateral venous occlusion or severe stenosis that renders standard upper limb access options non-viable. In many dialysis programmes, there will be patients who are considered to have exhausted definitive access options and are maintaining dialysis on a CVC. These patients can be classified as end-stage vascular access. As this group is disparate and comparisons of outcomes are difficult, it is proposed that a classification system should be used (5). Using the aforementioned definition, it could be said that our patient may be considered to have this rare condition, since all of the approaches were exhausted.

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