

A Cautionary Tale on the Central Venous Catheter: Medical Note for Oral Physicians

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Abstract

Complexity in the health status of patients with kidney disease forces to seek the aid of medical devices such as the central venous catheter (CVC) that is essential in order to perform hemodialysis. Elementary information about the CVC, as required for the oral healthcare professionals, has been documented so as to serve as a medical manual. This communication is the first of its kind that conjointly delineates vital considerations, which precede dental maneuvers in patients implanted with a CVC.

Keywords: *chronic kidney disease, central venous catheter, catheter related infection, hemodialysis, bacteremia, dental care*

Background

The patients, suffering from chronic kidney disease, have correlated oral symptoms requiring persistent attention to the dental tributaries. In such patients central venous catheter (CVC) dependence is inevitable for sustaining life as it is an essential requirement for hemodialysis. There is extensive data available in literature regarding dental management of CKD patients, but relatively meager information regarding its interconnection with CVC is available. The objective of this report is to analyse the unrecognised association between CVC and dental procedures.

Contents

This article begins with a preface to advances in health care disciplines and its impact on patients suffering from chronic kidney disease. It then discusses the utility of the central venous catheter (CVC) as a medical device. Subsequent sections start with a foreword pertinent to CVC followed by a discussion on its indications and drawbacks. Fundamental principles of CVC infection depicting the microbiology involved, prevalence, and management have been discussed prior to interpretation of its relationship with dentistry. Possible associations, risk factors, clinical significance and consequences of CVC patients with oral procedures have been highlighted. The final part describes the necessary requirements demanded from dental personnel while administering to CVC patients. The last section, conclusion, documents the limitations

of the undertaken study with a note on the future scope of research.

Introduction

In recent times, the health care industry has witnessed major breakthroughs, which have given a fresh hope to the patients suffering from fatal diseases. Due to remarkable medical advancement, ailments that were previously considered to be life threatening can now be cured. This has resulted in an increase in patient life expectancy. Patients suffering from kidney disease are among the major beneficiaries of such advancements in medical science. Chronic kidney disease (CKD) is a condition that exhibits as a progressive and undeniable decline in renal activity. Remarkably the disease shows association with dental issues and conditions. Multifarious oral symptoms noted in CKD patients require exceptional care from the oral healthcare professionals (1). The complexity of health issues in patients with kidney disease forces them to seek the aid of medical devices such as central venous catheter (CVC), which are essential to perform procedures such as hemodialysis. Annual reports of the United States Renal Data System indicate that more than 80% of kidney disease patients require a CVC to start hemodialysis (2). Recuperated information from the National Renal Registry (2011) reveals that around 2 6000 candidates are catheter dependant in the Malaysian continent (3). Afore mentioned data justifies that CKD is a major global health issue that requires exclusive attention from healthcare professionals.

Hence, an increased awareness of the oral manifestations and dental associations of patients suffering from CKD is of prime importance. The present paper aims to delineate the fundamental information regarding CVC and its association with dental procedure. The recommended protocols required for management of patients with CVC in dental office have been recovered from available literature.

Central venous catheter: Indications

CVC plays an important role in treatment of renal insufficiency. They serve as an alternative measure, especially in CKD patients, where the permanent access becomes non-functional. This medical tool consists of a small tube which is penetrated through the skin to reach a large vein in the patient's neck or groin region (Figure 1). This short procedure is routinely performed under local/general anesthesia. Right internal jugular vein, external jugular vein, common femoral vein, and subclavian vein are widely accepted as ideal sites for insertion of CVC. The first one is the most preferable due to the reason of the low incidence of infection at this site (4–8). CVC provides a simplified route for vascular access in CKD patients thus permitting the accomplishment of prolonged intravenous therapy. Apart from transfusion of blood and medication supplements, CVC also renders an

opportunity for these patients to be relieved from the hospital atmosphere. CVC is commonly employed in intensive care departments, but it is also convenient for outpatients given its advantageous benefits such as needless technique and freedom to use outside (9,10).

Central Venous Catheter: Drawbacks

Regardless of the positive indicators of CVC, it is coupled with complications in certain scenarios. Complications can be expected to arise either during the initial days of the CVC insertion period or later. Literature postulates that predicaments encountered within the first 90 days are considered to exert potential risk to CKD patients (11). On the grounds of duration, CVC complications can be designated as immediate or long-term. Bleeding, perforation of vein, air embolism, and improper placement of catheter can be classified as requiring immediate troubleshooting and can be deduced and handled with proficiency by renal surgeons. Catheter related infections (CRIs) are considered to be common long-term complications observed in hemodialysis candidates and are associated with increased mortality and morbidity in the aftermath of CVC infections (12–17). The outcomes of these detrimental reactions result in a further decline of the patient's medical status and have the potential to serve as a gateway for the development of bacterial endocarditis and septicemia (18). Existing aggravations have influenced multifarious scientific societies into developing frameworks designed to improve the quality of life in CKD patients. The National Kidney Foundation - Kidney Disease Outcomes Quality (NKF-KDOQI) has been making sincere efforts since 1997 towards rendering guidelines directed at improving the well being in CKD patients and has reported that the dependence on catheter usage has exceeded in spite of the steps taken to reduce their count (19). Reports extracted from Kidney Disease Improving Global Outcomes (KDIGO) also confirm the increased usage of CVC (20). The ease of placement and pain free technique attract the majority of the CKD patients urging them to rely on CVC despite the known adversity.



Figure 1: Central venous catheter insertion site

Catheter Related Infection: Etiology and Management

Unveiling of the CVC procedure in the early 1940s was equivalent to re-birth for patients with CKD in their battle for life (21). As a downside to its invention, infections resultant from CVC pose a threat and jeopardise the CKD patients. In a broad perspective, there are a couple of modes by which CVC can be infected: (a) skin, and (b) bacteremia (22). Culpable microorganisms involved in catheter infections are the *Staphylococcus* (gram positive cocci) and *Candida* species (fungi) and *Pseudomonas aeruginosa* (gram negative bacilli). These organisms invade the device during the insertion, and on few occasions bacteria acquired through surgeon hands have proven to be the sources of CRI's. The catheter tunnel serves as a locomotive carrier that facilitates entry of the *Staphylococcus aureus* and *epidermidis* pathogens into the host's bloodstream.

Medical devices have been held responsible for nosocomial infections in most of the reported subjects (21). Catheter related bloodstream infections (CBRSI) or catheter related sepsis contribute a major percentage to the development of hospital infections as CVC indirectly functions as a transporter for the contagions (23–27). The retrieved data from numerous clinical studies and surveillance reports have stated that the patients on hemodialysis are vulnerable to CRIs (10, 28–30). Once the CBRSI is diagnosed, removal of catheter is advised as the initial step. In addition to removal, the complications arising as a result of the CRBSI could be managed by the administration of broad spectrum antibiotics (vancomycin maintenance dose 25 mg/kg; loading dose 25-30 mg/kg) (31–34). The antibiotic regimen that is to be prescribed for infected (CRBS) patients is decided after perusing the positive culture reports. In terms of prolonged duration of prophylaxis, seeking advice from the microbiologist would be a moral choice. As a measure to control the infection rates in intensive care units, CVC 'bundles' based on the evidence based practice were introduced (35). Numerous elements such as of staff, maintaining meticulous hygiene of hand, ideal selection of insertion site, auditing the catheter chart, strict instructions to follow evidence based recommendations, and tracking the record of adherence to guidelines constitute the terminology CVC bundle. The package of protocols remarkably reduced the percentage of infections (35). Malaysia has its share of experience after the intervention was

brought into action in 2008. Statistics obtained from the Ministry of Health, Malaysia (2012) acknowledge that 15% of intensive care unit candidates were enrolled for hemodialysis and implementation of the CVC bundle brought about an increase of 9.2% on par with the previous year (36).

However, one must admit that CVC patients are prone to infections and a broader application of these interventions is still required to achieve satisfactory results. In order to scale down the hospital acquired infections, reputed international organisations have come forward and dictated guidelines after decades of undertaking extensive clinical research (37–41). The delivered guidelines, from honorary scholars which are being amended till date, have strict interventions for guiding health care personnel and dental-medical auxiliaries so as to avert the incidence of device-related infections in susceptible patients (42–49). To sum up, instructions and guidelines described insist on following standard aseptic procedures for the enlisted patients. Also, practice of sterile methodology during insertion of device, is a great precautionary measure aimed at reducing cross-infections (7,50).

Central Venous Catheter and Dental Procedure

The statistics and information detailed above are immeasurably helpful in answering the question: What should oral physicians know about CVC? The value of the gathered data increases in impact and clinical significance, for oral clinicians, when the related secondary question – why oral health care professionals should know about CVC? – is acknowledged. A vast majority of the CRI infections arise via skin or blood-borne route (12). Manipulation of oral tissue during intrusive dental procedures is considered to be one of the precipitating factors leading to infections among CVC patients (18).

The imperil health of CKD patients justifies their acknowledgment as medically compromised when they approach oral clinicians for seeking routine dental care. They deserve to be provided special oral health care owing to the large variety of their oral manifestations (1). Periodontal inflammation, dental caries, aphthous ulcer noticed in the CKD patients could function as mediators allowing the pathogens to enter the bloodstream. Poor quality of life, chemotherapy, older age, recent hospitalisation, diabetes mellitus, reduced frequency of dialysis further add on to the

list of host factors, which deteriorate the existing medical status of the CVC patient. These catalytic events act as key determinants in compromising their immune system and eventually leave them susceptible to infections. Taking into account that dental procedure could contribute as a source of contagion in CVC patient with such pre-disposing factors of CRIs, oral health care professionals ought to be conservative and cautious in executing dental treatment in CVC patients who are at high-risk. Occurrence of bacteremia is possible following surgical procedures and the threat is more in the aftermath of intrusive oral treatment (51). The described microorganisms in CRIs are routinely present in diverse oral flora, which could induce catheter infection preceding dental procedure and cause bacteremia (52). For the above reasons and anticipated threat, it is advisable to eradicate all the sources of infection, even though oral portals lack documentation in literature.

Several other clinicians have suggested that bacteremia could be a trigger in provoking CRIs and hence suggest an antibiotic regimen as a prerequisite of any dental procedure (12, 18, 41, 53–55). However, few authors claim the contrary and believe that antibiotics are a health-hazard for CVC patients because of their adverse reactions and the non-oral origin of involved pathogens (56–59). Prescription of antibiotics prior to invasive dental procedures to CVC patient is a controversial topic by virtue of the arguments received in favor and against the antibiotic regimen. Therefore, it is not possible to conclude that prophylactic antibiotic treatment is useful in averting CRIs. However, as the provided evidence assures that CVC patients can fall victim of infection during the routine oral care, nephrologists' advice dentist to preferably initiate dental treatment only after six months of the insertion of CVC (60). Even though, scarcity of evidence clouds the exact nature of the contribution of oral bacteremia in CVC patients, dentists cannot underrate the plausible risk factors as it could turn out to be perilous.

Dentist's Corner

From the dental surgeon's perspective, there are few crucial considerations for CVC patients visiting a dental office. Honest conversation with nephrologists is mandatory to attain a better understanding of patient's current medical status (1). Examination of the CVC patient with a history of medical issues must be more comprehensive. The physical investigation should encompass the

patients general countenance, blood pressure, temperature, pulse and respiratory rate, palpation of lymph nodes in head and neck region, salivary glands assessment, and evaluation of breath. CKD patients undergoing dialysis are at potential risk of excessive bleeding as frequent transfusions and friction of the CVC causes damage which leads to platelet dysfunction. The inevitable trauma could deteriorate the oral status and therefore a total blood count is to be performed to circumvent complications. Predisposition to bleeding can be effectively controlled if the dental treatment is performed on the day preceding hemodialysis. Still, dental procedure should commence and conclude with a measurement of blood pressure so as to maintain the expected hypertension predominantly seen in dialysis subjects (61–62). Irrespective of the unidentified incidence of hypertension in CKD patients, dentists should consider its consequences in stimulating cardiovascular risks (63). Renin-angiotensin blockers are authenticated as first line drugs for hypertensive CVC patients followed by beta-blockers as drugs of second choice (64–66).

Averting excessive tension and anxiety in the dental chair is cardinal to sustain the blood pressure (67). Ensure that the patient is seated in a comfortable position on the dental couch during the entire procedure. Effective control of operative and postoperative pain during and after dental procedures is one of the most pronominal things the dentist can do to minimise blood pressure. In exceptional situations, wherein the patients present with a dental emergency, antibiotic prophylaxis as recommended by the American Health Association (AHA), the organisation accepted worldwide (amoxicillin 2 g, an hour prior the dental treatment) is advised (68–72). Considering patients well being on account of managing the oral complications under the supervision of a renal physician, it would be safer for the patient to be referred to a medical hospital with dental specialty. Furthermore, with regard to the pharmacologic prescriptions, seeking individual opinion from a nephrologist so as to adjust the dosage of drugs reduces the risk factors associated with anti-microbial resistance (AMR), which has been extensively documented in the literature (73–80).

Limitations

The information outlined above aims to impart vital information about CVC to dental practitioners. This would unquestionably fulfill the beginners note in dental diary, but a few limitations do exist in the present communication. Further discussion and accumulation of evidence pertaining to controversies surrounding antibiotic prophylactic treatment prior to invasive dental treatment and dental considerations in managing the complications of CKD patients and dental association of CRIs with different types of CVC are required.

Conclusion

Within the limitations of this communication, it can be corroborated that CVC benefits CKD patients while simultaneously posing a potential risk for the long term candidates. Despite the foreseen after-effects of misuse, the greater benefits in CVC make them popular among the CKD patients. However, negligence shown in sterilisation and disinfection methods during the insertion of the device (CVC) could be proved fatal to CVC patients. In the light of the dentists' point of view, the implanted device (CVC) is an alien (foreign body) object and has the highest possible chances of being infected during oral care in an immune compromised host. Cognizance of the adverse effects of CRIs and its anticipated association with dental issues require a better perception from the medical-dental experts so as to minimise the increasing mortality rate in hemodialysis patients. The dental surgeon's interest in updating the research related to medical perspective in CVC patient will aid them in enhancing their general health.

Recommended Protocols

Despite the health care professional's proficiency, complications might be encountered during routine care of patients in medical-dentistry. To avoid the anticipated crisis situations in future, protocols have been framed from the above cautionary tale so as to marshal the experts. These are:

- Interact with the nephrologist prior to dental treatment in order to retrieve medical history and amend drug dosages;
- Schedule the dental visit during non-dialysis days;
- Monitor blood pressure in every dental

appointment;

- Ensure comfortable position of patient in dental chair;
- Administer antibiotic prophylaxis (AHA guidelines) for high-risk patients after communicating with renal surgeon;
- Adhere to fundamental sterilisation and disinfection procedures in dental operations.

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Conflicts of Interest

None

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