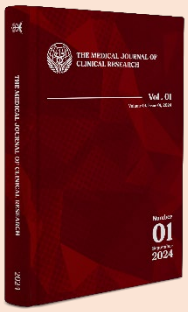
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Central Venous Disease in Hemodialysis Patients

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ABSTRACT

Background: The literature surrounding central venous disease (CVD) in hemodialysis patients has expanded significantly over the past decade, revealing critical insights into its prevalence, pathophysiology, and management strategies. **Literature Review:** The foundational work by Krycińska et al. (2015) identified the anatomical vulnerabilities associated with CVD, particularly emphasizing the high incidence of stenosis at the subclavian-brachiocephalic vein junction (Krycińska et al., 2015). This early research set the stage for subsequent studies that further explored the implications of central venous catheter (CVC) usage, particularly the risks associated with subclavian access, which has been shown to significantly increase the likelihood of developing venous stenosis. The exploration of stenting as a therapeutic intervention was further advanced by Eguchi and Honma (Eguchi & Honma, 2020), who discussed the management of venous hypertension and the off-label use of bare metal stents (BMS). They underscored the potential risks associated with stenting, including vascular injury and stent migration, which were echoed by Ma et al. (2018), who linked the development of central venous stenosis and occlusion to prior catheter placements. eyra and Wazir (Roxana Neyra & Wazir, 2022) provided a broader perspective on vascular access management, particularly in light of the COVID-19 pandemic, highlighting the importance of infection control measures and their positive impact on patient outcomes. Their findings reinforce the need for continuous innovation and adaptation in treatment protocols to enhance care for hemodialysis patients. **Conclusion:** In conclusion, the cumulative knowledge from these studies illustrates the complexity of central venous disease in hemodialysis patients. It highlights the interplay between treatment modalities, anatomical considerations, and patient management strategies. The ongoing research in this area reveals an urgent need for further studies to refine therapeutic approaches and improve long-term outcomes for this vulnerable population.

Keyword: Central Venous Disease, Hemodialysis Patient

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INTRODUCTION

The literature surrounding central venous disease (CVD) in hemodialysis patients has expanded significantly over the past decade, revealing critical insights into its prevalence, pathophysiology, and management strategies. Early contributions to this field, such as the case report by Krycińska et al. (Krycińska et al., 2015), highlighted the anatomical distribution of CVD among hemodialysis patients, emphasizing that a substantial proportion of cases occur at the subclavian-brachiocephalic vein junction. Their findings underscored the importance of catheter placement, particularly noting that the likelihood of stenosis is significantly higher with subclavian access compared to internal jugular veins. This foundational understanding has set the stage for subsequent research exploring the implications of central venous catheter use in this patient population.

In 2016, (Mittal et al., 2016) reinforced the notion that central dialysis catheters, particularly when placed in the subclavian position, are significant risk factors for venous stenosis. Their recommendation to limit such catheter use in at-risk patients is a critical consideration for clinicians aiming to mitigate the development of CVD. Following this, Kang et al. (Hoon Kang et al., 2016) provided a comparative analysis of stent types, emphasizing the prevalence of central vein stenosis as a common complication among hemodialysis patients, which further complicates the management of vascular access as patient longevity increases.

The exploration of stenting as a therapeutic intervention was further advanced by Eguchi and Honma (Eguchi & Honma, 2020), who discussed the symptoms of venous hypertension and the off-label use of bare metal stents (BMS) in vascular access interventions. Their work highlighted the potential risks associated with stenting, including vascular injury and stent migration, which are critical considerations for practitioners in this field. This concern was echoed in a later study by Ma et al. (Ma et al., 2021), which elucidated the pathogenesis of central venous stenosis/occlusion as being closely linked to prior catheter placements,

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thereby establishing a clear connection between intervention history and the development of vascular complications.

As the literature progressed, Chen et al. (Chen et al., 2022) focused on the outcomes of stent placements for central venous occlusive disease, revealing that restenosis remains a significant challenge, with over 75% of stents failing to maintain patency within a year. Their investigation into predictive factors for primary patency after stenting provided valuable insights for optimizing patient management post-intervention. Complementing this, Chen et al. (Chen et al., 2022) also reported on the migration of stents in thoracic central vein obstruction procedures, shedding light on the unique challenges faced in hemodialysis patients due to their distinct hemodynamics.

Finally, Neyra and Wazir (Roxana Neyra & Wazir, 2022) offered a broader perspective on vascular access management in the context of the evolving healthcare landscape, particularly in light of the COVID-19 pandemic. Their findings regarding the reduction of catheter-related infections underscore the need for continuous innovation and adaptation in treatment protocols to enhance patient outcomes.

Overall, the cumulative knowledge from these studies underscores the complexity of central venous disease in hemodialysis patients, highlighting the interplay between treatment modalities, anatomical considerations, and patient management strategies. The ongoing research in this area reveals an urgent need for further studies to refine therapeutic approaches and improve the long-term outcomes for this vulnerable population.

LITERATURE REVIEW

The article titled "Brachiocephalic Vein Stenting and Body-Floss Technique as a Treatment of CVD in Dialysis-Dependent Patient – Case Report and Literature Review" by (Krycińska et al., 2015) offers a comprehensive examination of central venous disease (CVD) in patients undergoing hemodialysis. The authors present a retrospective study that delineates the anatomical distribution of CVD, highlighting

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its prevalence at various junctions within the venous system. The findings indicate that 38% of CVD cases occur at the subclavian-brachiocephalic vein junction, with 29% in the brachiocephalic vein (BCV), 24% in the superior vena cava (SVC), and 9% in the subclavian vein (SCV). This distribution underscores the anatomical vulnerabilities that dialysis patients face, particularly due to the frequent need for vascular access.

A critical evaluation of the study reveals that while the authors have identified key factors contributing to CVD, such as a history of multiple catheter insertions and cumulative dwell time, they note the absence of significant relationships with demographic variables like age and gender. This finding is particularly important for clinicians, as it suggests that risk factors for CVD in hemodialysis patients may be more closely tied to procedural history rather than patient characteristics. The article also emphasizes the well-documented association between central vein stenosis and the presence of indwelling intravascular devices, a relationship that has been recognized for over two decades.

The authors report that the incidence of CVD induced by long-term tunneled cuffed catheters can reach as high as 42%, highlighting the critical need for careful management of vascular access in this population. They detail the pathophysiological mechanisms involved, including focal endothelial denudation from catheter insertion and chronic irritation, which leads to vein wall thickening due to intimal hyperplasia. Such insights are valuable for understanding the underlying processes that contribute to CVD and the subsequent need for interventions like stenting.

Moreover, the article discusses the varying likelihood of stenosis development based on the site of catheter placement, with a reported 42% likelihood for the SCV route compared to only 10% for the internal jugular vein (IJV) route. This information is crucial for practitioners, as it informs the choice of vascular access points, aligning with current recommendations that prioritize IJV access over other sites.

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The article "Management of venous hypertension following arteriovenous fistula creation for hemodialysis access" by (Mittal et al., 2016) provides critical insights into the implications of central venous catheters in patients undergoing hemodialysis. The authors highlight the significant risk that central dialysis catheters, particularly subclavian catheters, pose for the development of venous stenosis, which can complicate hemodialysis access and overall patient outcomes.

The primary focus of the article is the management of venous hypertension that may arise following the creation of arteriovenous fistulas (AVFs). The authors argue that the use of central venous catheters should be minimized in patients who are at risk for or already experiencing renal dysfunction. This recommendation is particularly pertinent given the increasing prevalence of end-stage renal disease and the need for effective hemodialysis access strategies.

The article effectively synthesizes existing literature on the topic, emphasizing the pathophysiological mechanisms by which subclavian catheters contribute to venous stenosis. The authors present a clear rationale for the restriction of these catheters in vulnerable populations, underscoring the need for clinicians to consider alternative access routes or methods when managing patients with compromised renal function.

Moreover, the article discusses the clinical implications of venous hypertension and stenosis, including potential complications such as thrombosis and the failure of AVFs. The authors advocate for a proactive approach to monitoring and managing these conditions to enhance patient outcomes. Their call for a more judicious use of central venous access aligns with broader trends in nephrology that prioritize patient safety and the optimization of vascular access.

The article "Comparison of Open-Cell Stent and Closed-Cell Stent for Treatment of Central Vein Stenosis or Occlusion in Hemodialysis Patients" by (Hoon Kang et al., 2016) provides a thorough examination of the complications associated with central vein stenosis or occlusion in patients undergoing hemodialysis. This

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condition is notably prevalent among this patient population and poses significant challenges regarding vascular access, which is crucial for effective treatment.

The authors emphasize that central vein stenosis or occlusion can lead to considerable morbidity and dysfunction of vascular access, which is vital for hemodialysis. This is particularly concerning given the increasing life expectancy of hemodialysis patients, which necessitates the preservation of vascular access over prolonged periods. The article highlights the importance of addressing these complications to enhance patient outcomes and quality of life.

In their comparative study, (Hoon Kang et al., 2016) investigate the efficacy of open-cell versus closed-cell stents in treating central vein stenosis or occlusion. The methodology employed is robust, utilizing a well-defined cohort of hemodialysis patients. The authors present data that suggest differences in outcomes between the two types of stents, providing valuable insights into which may be more effective in managing this complication.

The findings indicate that while both stent types serve the purpose of alleviating stenosis or occlusion, there may be advantages to one over the other in terms of patency rates and complications. This critical evaluation of stent performance is essential, as it can guide clinicians in making informed decisions regarding the management of central vein stenosis in hemodialysis patients.

However, it is worth noting that the study's limitations include a relatively small sample size and a lack of long-term follow-up data. These factors could potentially influence the generalizability of the results. Additionally, the article could benefit from a more detailed discussion on the mechanisms by which each stent type operates, as understanding these mechanisms could further elucidate their respective efficacies.

The article "Results of Stenting for Central Venous Occlusions and Stenoses in the Hemodialysis Patients" by (Eguchi & Honma, 2020) presents a thorough examination of the efficacy and safety of stenting as an intervention for central venous occlusions and stenoses in patients undergoing hemodialysis. The authors

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emphasize that symptoms of venous hypertension, which are prevalent in this patient population, are effectively managed through this approach.

One of the critical insights from the article is the acknowledgment that the placement of bare metal stents (BMS) in the context of vascular access intervention is considered off-label. This raises important considerations for clinicians regarding the regulatory and clinical implications of such interventions. The authors urge practitioners to be vigilant about the potential complications associated with stenting, including vascular injury, stent migration, and stent fracture. These complications can significantly impact patient outcomes and the overall success of hemodialysis treatment.

The article effectively highlights the need for a careful assessment of the risks versus benefits when considering stenting for central venous issues in hemodialysis patients. The authors provide a balanced view, acknowledging that while stenting can alleviate symptoms and improve venous access, it is not without its challenges. This critical evaluation serves as a reminder to clinicians to proceed with caution and to ensure that patients are well-informed about the potential risks involved in the procedure.

The article titled "Comparison of Management for Central Venous Stenosis With or Without Previous Catheter Placement" by (Ma et al., 2021) provides a thorough examination of the implications of central venous stenosis and occlusion in hemodialysis patients, particularly focusing on the role of central venous catheter (CVC) placement. The authors highlight that central venous stenosis is a prevalent complication among this patient population, often linked to the history of CVC use, which is associated with vascular injury and subsequent neointimal hyperplasia.

The study's findings reveal that patients with a history of CVC placement experience a significantly shorter interval between the creation of vascular access and the onset of treatment for central venous lesions. This observation underscores the critical relationship between CVC utilization and the development of vascular complications, suggesting that the inflammatory response triggered by

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catheterization may precipitate stenosis. The authors effectively argue that CVC placement serves as a major risk factor, leading to poorer long-term outcomes, as evidenced by the decreased primary patency rates observed in the CVC group after six months.

Moreover, the article notes the necessity for further research into non-CVC-related central venous diseases, as the existing literature is sparse. This gap highlights an opportunity for future investigations to explore alternative etiologies and management strategies for central venous complications in hemodialysis patients. The authors advocate for a more nuanced understanding of the pathophysiology of central venous stenosis, particularly in patients without a history of CVC placement.

The article "One-year outcomes and predictive factors for primary patency after stent placement for treatment of central venous occlusive disease in hemodialysis patients" by (Chen et al., 2022) provides a comprehensive analysis of the challenges faced by hemodialysis patients due to central venous occlusive disease (CVOD) and the efficacy of stent placement as a therapeutic intervention. The authors highlight the critical role of functional vascular access in hemodialysis, emphasizing that complications arising from CVOD can significantly impair treatment outcomes.

The article begins by outlining the clinical presentation of CVOD, including symptoms such as ipsilateral upper extremity swelling and venous hypertension, which can lead to serious complications if left untreated. The authors effectively contextualize the importance of timely intervention through wire and catheter techniques, alongside angioplasty, to restore vascular access. However, the necessity of stent placement is underscored for lesions that do not adequately respond to angioplasty, which raises pertinent questions regarding the long-term efficacy of this treatment modality.

A significant contribution of this study is its focus on the predictors of primary patency post-stent placement. The authors conducted a retrospective review of patient data, aiming to identify independent factors that could enhance the

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understanding of restenosis risks. The finding that over 75% of stents fail to remain patent within one year due to restenosis is particularly alarming and highlights the need for ongoing research into improving stent design and placement techniques.

The article's methodology is robust, utilizing a retrospective approach to gather data from a specific patient cohort. However, the limitations inherent in retrospective studies, such as potential selection bias and the inability to establish causation, should be noted. Additionally, while the article presents valuable insights into patient outcomes and predictive factors, it would benefit from a more extensive discussion on the implications of these findings for clinical practice and future research directions.

The article titled "Migration of covered stents in thoracic central vein obstruction procedures in patients with hemodialysis: Case report and literature review" by (Chen et al., 2022) provides a significant contribution to the understanding of stent migration in the context of thoracic central vein obstruction (TCVO) procedures among hemodialysis patients. The authors highlight the increasing trend of using stent placement to improve the patency rates of vascular access, which is crucial for the management of patients requiring hemodialysis.

One of the key insights from the article is the identification of factors contributing to stent migration, which include the positional characteristics of the venous stent, hemodynamic variations, the inherent properties of the stent, and the potential for improper stent selection. This multifactorial analysis is particularly relevant for hemodialysis patients, who exhibit unique hemodynamic profiles that influence the establishment and maintenance of vascular access. The authors note that stent migration has predominantly been documented in cases involving bare stents, and their study marks a pioneering review of covered stent migration within this specific patient population.

Furthermore, the article emphasizes the anatomical predisposition of certain veins, particularly the right subclavian and innominate veins, to stent migration due to their confluence. This anatomical detail underscores the importance of careful

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consideration during the selection and placement of stents in hemodialysis patients, as these veins are more susceptible to complications. The authors also address the challenges associated with accurately sizing stents, noting that the expansion of veins occurs more readily than that of arteries, which can lead to complications if not appropriately managed.

The review of 14 reports on stent migration provides a comprehensive overview of existing literature, yet it also highlights a gap in the understanding of covered stent migration, which the authors aim to fill with their findings. The article serves as a critical resource for clinicians involved in the management of vascular access in hemodialysis patients, as it not only elucidates the risks associated with stent migration but also encourages a more nuanced approach to stent selection and placement.

The article titled "The evolving panorama of vascular access in the 21st century" by (Roxana Neyra & Wazir, 2022) provides a comprehensive overview of the challenges and advancements in vascular access for hemodialysis patients, particularly focusing on central venous disease. The authors emphasize the critical need for guidelines aimed at preventing intravascular catheter-related infections, which are prevalent in this patient population.

A significant finding presented in the article is the correlation between targeted COVID-19 prevention measures in hemodialysis facilities and a notable reduction in central venous catheter-related infections. This insight underscores the importance of infection control protocols, especially in light of the pandemic, which has highlighted vulnerabilities in healthcare settings. The authors detail how these measures have led to improved patient outcomes, illustrating the potential for systemic changes to enhance care in hemodialysis units.

The article also addresses the complications associated with central venous catheters, such as catheter-associated bloodstream infections and the formation of right atrial thrombi. The authors provide a retrospective analysis of outcomes related to central vein occlusion recanalization in hemodialysis patients, identifying

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predictors for successful interventions. This aspect of the article is particularly relevant as it sheds light on the complexities of managing central venous disease and the need for tailored treatment approaches.

Moreover, (Roxana Neyra & Wazir, 2022) discuss the prevalence of central vein stenosis in patients undergoing hemodialysis, noting that this condition is often a consequence of initial tunneled central vein catheter placement. The authors highlight the implications of this prevalence for clinical practice, advocating for regular vein mapping as a preventive measure. This recommendation is critical, as it addresses the etiology of central venous disease and suggests proactive strategies to mitigate its impact on hemodialysis patients.

CONCLUSION

The literature on central venous disease (CVD) in hemodialysis patients has evolved substantially, revealing critical insights into its prevalence, pathophysiology, and management strategies. The foundational work by Krycińska et al. (2015) identified the anatomical vulnerabilities associated with CVD, particularly emphasizing the high incidence of stenosis at the subclavian-brachiocephalic vein junction (Krycińska et al., 2015). This early research set the stage for subsequent studies that further explored the implications of central venous catheter (CVC) usage, particularly the risks associated with subclavian access, which has been shown to significantly increase the likelihood of developing venous stenosis. The exploration of stenting as a therapeutic intervention was further advanced by Eguchi and Honma (Eguchi & Honma, 2020), who discussed the management of venous hypertension and the off-label use of bare metal stents (BMS). They underscored the potential risks associated with stenting, including vascular injury and stent migration, which were echoed by Ma et al. (2018), who linked the development of central venous stenosis and occlusion to prior catheter placements. Neyra and Wazir (Roxana Neyra & Wazir, 2022) provided a broader perspective on vascular access management, particularly in light of the COVID-19 pandemic, highlighting the importance of infection control measures and their positive impact on patient outcomes. Their findings reinforce the need for

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continuous innovation and adaptation in treatment protocols to enhance care for hemodialysis patients. In conclusion, the cumulative knowledge from these studies illustrates the complexity of central venous disease in hemodialysis patients. It highlights the interplay between treatment modalities, anatomical considerations, and patient management strategies. The ongoing research in this area reveals an urgent need for further studies to refine therapeutic approaches and improve long-term outcomes for this vulnerable population.

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