

REVIEW ARTICLE

Management of hypertension in the hemodialysis population: a review of the literature

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Objective: The objective of this paper was to propose an algorithm for approaching hypertensive hemodialysis patients admitted to the hospital for hypertensive urgency.

Methods: A literature search was conducted using PubMed (Medline). Articles selected were limited to humans and the English language.

Results: We identified eight management modalities including: short-daily and nocturnal dialysis, sodium restriction, sodium profiling, antihypertensive medications, sympathetic denervation, bilateral nephrectomy, and bioimpedance spectroscopy. The benefits and drawbacks of each were investigated and discussed before implementation into the algorithm.

Discussion: The algorithm presented suggests a linear approach to patient care, but treatment modalities may not be mutually exclusive, and additional factors, such as patient compliance and individual health status, should be taken into account to provide patients with optimum care.

Keywords: *hypertension; hemodialysis; algorithm; sodium dialysate; anti-hypertensive medication*

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Patients with hypertension (HTN) are often asymptomatic, but the consequences, if left untreated, may be devastating. The Kidney Disease: Improving Global Outcomes provides national guidelines in clinical practice for blood pressure control in the non-dialysis-dependent chronic kidney disease population. However, clearly defined guidelines are not available for hypertensive patients in the hemodialysis (HD) population. For practicing physicians, the absence of a specific protocol may present challenges in managing such patients admitted to the hospital for hypertensive urgency. Thus, the goal of this paper was to conduct a literature search and identify specific interventions for this patient population. Although additional studies are needed to adequately draw therapeutic conclusions, the proposed algorithm serves as a summary of the recommendations presented in current literature.

Whether a patient is in an early stage of kidney disease or has progressed to end-stage renal disease (ESRD) and is dependent on dialysis, maintaining blood pressure continues to play a critical role. A systematic review and meta-analysis of randomized controlled trials published in 2009 reported that blood pressure-lowering treatment was associated with a reduced risk of cardiovascular

events, all-cause mortality, and cardiovascular mortality in dialysis patients (1).

HD provides better volume control in ESRD patients by achieving a patient's dry weight, defined as the postdialysis body mass at which the patient neither retains excess fluid nor experiences symptoms of hypotension. Even with HD, however, nearly 50–60% of patients continue to suffer from HTN (2). As such, additional strategies to reduce blood pressure should be implemented alongside the dialysis plan. The HTN management options to achieve volume control that were investigated in this article include:

1. Prolonged or increased frequency of HD
2. Sodium control (dietary and dialysate sodium prescriptions)
3. Antihypertensive agents
4. Sympathetic denervation
5. Bilateral nephrectomy
6. Bioimpedance spectroscopy

Methods

The search for HTN management options in the HD population was conducted using PubMed (Medline). We identified relevant literature, particularly those using

Table 1. Search keywords for advanced PubMed search with systematic review, meta-analysis, or no filter specified

Medical subject headings (MeSH) keywords:

- Dialysis solution + hypertension
- Hypertension + hemodialysis
- Kidney failure, chronic + hypertension
- Anti-HTN medication + hemodialysis

the systematic review and meta-analysis methodologies. Articles included were limited to humans and the English language. The search keywords applied are shown in Table 1. If relevant systematic reviews or meta-analysis were not found, the search criteria were broadened to include all other forms of literature by removing the systematic review and meta-analysis filter.

Results

The literature selected for this project is summarized in Table 2.

Eight interventions were investigated for managing HTN in the HD population; seven showed benefits in patient care as measured by improvements in blood pressure control, decrease in prescribed antihypertensive medications, or less interdialytic weight gain. The description and findings from each intervention are summarized in Table 3.

Algorithm

An algorithm summarizing the findings from the literature review was proposed to serve as an initial guide to managing HD patients admitted for hypertensive urgency because specific guidelines are not currently available. Until further investigation and recommendations can be made, this algorithm provides a stepwise approach that may assist physicians in optimizing care from acute presentation to long-term management.

In the acute setting, a HD patient with fluid overload should be given pharmacologic intervention as they are prepared for emergency dialysis. Common intravenous medications administered include labetalol and nicardipine. Once stabilized, long-term management strategies should be implemented. Common home medication regimens include β -blockers, calcium channel blockers, Angiotensin converting enzyme inhibitors (ACE inhibitors), and Angiotensin receptor blockers (ARBs). Because some parameters may present ambiguity, Table 4 clarifies factors presented in the algorithm that may be difficult to define in clinical practice Fig. 1.

Conclusion

The goal of this article was to search the PubMed database and broadly address the clinical question of how to manage HTN in HD patients, a population for whom specific guidelines are not currently available. Because the underlying mechanism and pathophysiology of acute and chronic HTN are similar, the literature findings were applied to both immediate and long-term patient care. Although additional research and investigation are required to optimize care, the proposed algorithm provides a stepping stone for practicing physicians faced with the clinical scenario described.

Although the algorithm presented suggests a linear approach, it is important to note that multiple management modalities may benefit a single patient and treatment options are not mutually exclusive. Additionally, it is imperative to take a patient's individual health status, comorbidities, and personal preferences into account when providing care. Perhaps the most important factor to consider after stabilizing a HD patient admitted for hypertensive urgency is adherence to the assigned treatment regimen. Explaining the significance of patient cooperation may present the most efficient and proactive method of treatment. Once established, the additional

Table 2. Summary of literature findings

Intervention	Type of literature	Special notes
Short-daily HD	1 systematic review	
	1 meta-analysis	
Nocturnal HD	1 systematic review	
Sodium restriction	1 combined systematic review and meta-analysis	Article not specific to HD patients
Sodium dialysate solution	1 in-depth review	
	1 clinical trial	
Anti-HTN medication	1 combined systematic review and meta-analysis	
Sympathetic denervation	1 systematic review	SR not specific to HD patients
	1 case report (HD + HTN patient)	
Bilateral nephrectomy	1 clinical trial	
Bioimpedance spectroscopy	1 clinical trial	

Table 3. Summary of literature search results for the management of hypertension in hemodialysis patients in intervention groups

Intervention	Description of technique	Findings
Short-daily HD (3, 4)	<ul style="list-style-type: none"> Performed approximately 5–7 times per week for 1.5–3 hour duration 	<ul style="list-style-type: none"> Improvements in blood pressure control Discontinuation or reduction in mean number of anti-HTN drugs
Nocturnal HD (5)	<ul style="list-style-type: none"> Performed approximately 6 nights a week 	
Sodium restriction (6)	<ul style="list-style-type: none"> Restricting dietary sodium leads to less water retention and interdialytic weight gains 	<ul style="list-style-type: none"> Greater blood pressure drop in hypertensive patients than general population Daily sodium intake ≤ 2 grams recommended
Sodium profiling (7, 8)	<ul style="list-style-type: none"> Gradual reduction of sodium dialysate concentration to match patient's individualized plasma sodium level (normal range between 135–145 mEq/L) 	<ul style="list-style-type: none"> Pre-HD sodium concentration is a safe and effective means to manage HTN in HD patients Modest reductions decrease blood pressure and are well-tolerated in non-hypotensive prone patients Decrease in interdialytic weight gain
Anti-HTN agents (1)	<ul style="list-style-type: none"> Many classes with different targets <ul style="list-style-type: none"> Adrenergic receptor antagonists (α-blockers, β-blockers) Calcium channel blockers (CCB) ACE inhibitors and ARBs Centrally acting agents 	<ul style="list-style-type: none"> In general, reduced cardiovascular morbidity and mortality β-Blockers, CCBs, ACE inhibitors, and ARBs are appropriate primary choices for HD patients α-Blockers and central acting agents recommended as secondary choices Assign medication according to patient comorbidities
Sympathetic denervation (9)	<ul style="list-style-type: none"> Catheter-based radiofrequency energy interrupts sympathetic nervous system in renal arteries 	<ul style="list-style-type: none"> Patients with resistant HTN showed significant reduction in systolic and diastolic pressures with no reported worsening of kidney function postdenervation
Bilateral nephrectomy (10)	<ul style="list-style-type: none"> Removing kidneys reduces circulating levels of renin, angiotensin I and angiotensin II 	<ul style="list-style-type: none"> Largely abandoned with introduction of anti-HTN medication Rarely practiced due to negative outcomes
Bioimpedance spectroscopy (11)	<ul style="list-style-type: none"> Recently proposed technique using fluid model to determine fluid overload 	<ul style="list-style-type: none"> Decrease in postdialysis body weight, better blood pressure levels and decreased use of anti-HTN medication

Table 4. Clarification of parameters presented in algorithm that may be difficult to assess

Life style modification	<ul style="list-style-type: none"> Salt restriction and healthy diet Weight control (interdialytic weight gain) Exercise Monitor daily blood pressure
Response to anti-HTN medication	<ul style="list-style-type: none"> Ensure patient receiving optimal and/or maximum recommended dose Consider changing or adding anti-HTN meds to treatment regimen Take individual patient characteristics (e.g., race, comorbidities) into account
Compliance with medication	<ul style="list-style-type: none"> Cost of medication Mental status Education Gross negligence
Secondary HTN	<ul style="list-style-type: none"> Examples include: renovascular disease and hyperaldosteronism

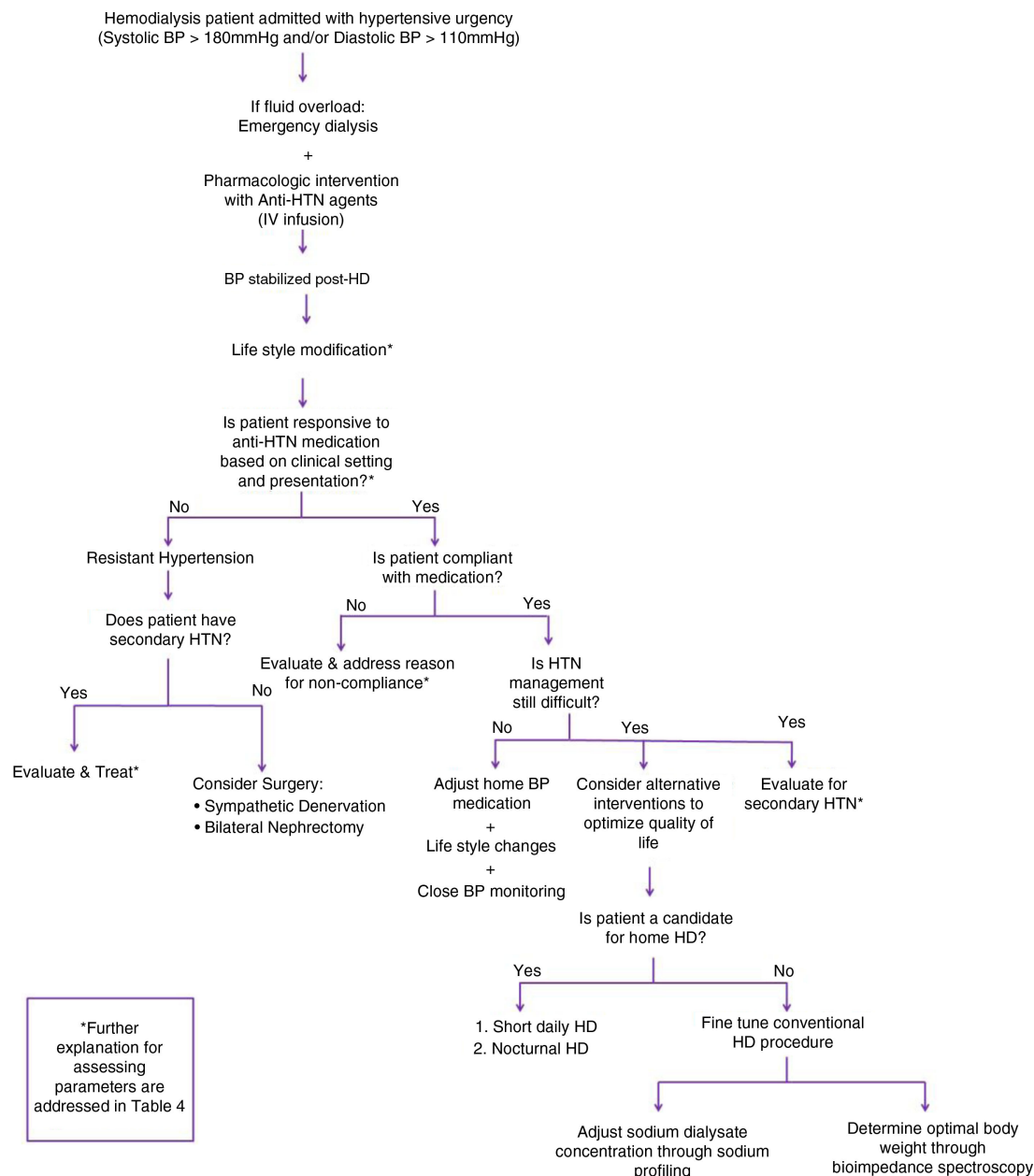


Fig. 1. Proposed algorithm for the management of hypertension in a hemodialysis patient admitted to the hospital for hypertensive urgency.

management methodologies presented in this article are beneficial in optimizing a patient’s quality of life.

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The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

References

1. Heerspink HJL, Ninomiya T, Zoungas S, de Zeeuw D, Grobbee DE, Jardine MJ, et al. Effect of lowering blood pressure on cardiovascular events and mortality in patients on dialysis: A systematic review and meta-analysis of randomised controlled trials. *Lancet* 2009; 373: 1009–15.
2. Henrich WL, Lionel U. Mailloux. In: Schwab SJ, et al. eds. Hypertension in hemodialysis patients. Waltham, MA: UpToDate; 2013.
3. Puña J, Lema LV, Sanchez-Guisande D, Ruano-Ravina A. Clinical effectiveness and quality of life of conventional haemodialysis versus short daily haemodialysis: A systematic review. *Nephrol Dial Transplant* 2008; 23: 2634–46.
4. Susantitaphong P, Koulouridis I, Balk EM, Madias NE, Jaber BL. Effect of frequent or extended hemodialysis on cardiovascular parameters: A meta-analysis. *Am J Kidney Dis* 2012; 59(5): 689–99.
5. Walsh M, Culleton B, Tonelli M, Manns B. A Systematic review of the effect of nocturnal hemodialysis on blood pressure, left

- ventricular hypertrophy, anemia, mineral metabolism, and health-related quality of life. *Kidney Int* 2005; 67: 1500–8.
6. Aburto NJ, Ziolkovska A, Hooper L, Elliott P, Cappuccio FP, Meerpohl JJ, et al. Effect of lower sodium intake on health: a systematic review and meta-analysis. *Br M J* 2013; 1–20.
 7. Elshahawy Y, Sany D, Shawky S. Outcome of individualized dialysate sodium concentration for hemodialysis patients. *Saudi J Kidney Dis Transpl* 2013; 24(3): 507–13.
 8. Santos SFF, Peixoto AJ. Revisiting the dialysate sodium prescription as a tool for better blood pressure and interdialytic weight gain management in hemodialysis patients. *Am Soc Nephrol* 2008; 3: 522–30.
 9. Gosain P, Garimella PS, Hard PD, Agarwal R. Renal sympathetic denervation for treatment of resistant hypertension: A systematic review. *Official J Am Soc Hypertens* 2013; 15(1): 75–84.
 10. Medina A, Bell PR, Briggs JD, Brown JJ, Fine A, Lever AF, et al. Changes of blood pressure, renin, and angiotensin after bilateral nephrectomy in patients with chronic renal failure. *Br Med J* 1972; 4(5842): 694–6.
 11. Hur E, Usta M, Toz H, Asci G, Wabel P, Kahvecioglu S, et al. Effect of fluid management guided by bioimpedance spectroscopy on cardiovascular parameters in hemodialysis patients: A randomized controlled trials. *Am J Kidney Dis* 2013; 61(6): 957–65.