Learning Package

Health
Hunter New England
Local Health District

Renal: Advanced Fluid Assessment

Sites where Learning package applies	Clinical areas where care is provided to patients with renal disease
Description	This learning package explores the principle of clinical fluid assessment, especially for patients with End Stage Kidney Disease on maintenance dialysis
Target audience	Enrolled Nurses & Registered Nurses working in the area of nephrology nursing.
Learning Outcomes, On completion of this package you will be better able to:	• Understand the normal mechanisms of fluid balance within the body • Explain the changes to fluid balance regulation that occurs in renal disease • Understand the physical changes and complications that occur in hypovolemia and hypervolemia in patients with Chronic Kidney Disease stage 4 and 5 • Understand all parts of clinical assessment including medical history, biochemistry findings, physical assessment and treatment review related to fluid assessment • Consolidation of understanding of the principle of clinical assessment and its role in the nurses' dialysis care plan and/or prescription
Keywords	Haemodialysis, Renal, Fluid Assessment, Dialysis
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Related Legislation, Australian Standard, NSW Ministry of Health Policy Directive or Guideline, National Safety and Quality Health Service Standard (NSQHSS) and/or other, HNE Health Document, Professional Guideline, Code of Practice or Ethics:

- Infection Prevention and Control Policy [PD2017_013]
- NSW Health Policy PD 2005_406 Consent to Medical Treatment http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_406.pdf
- Renal Guidelines and Procedures http://ppg.hne.health.nsw.gov.au/

Is this package recorded in MyHealth learning?	Renal: Advanced Fluid Assessment (168549912)
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Renal: Advanced Fluid Assessment

Learning Package

2018

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Learning Package Overview

Purpose: *This package on advanced fluid assessment explores the principle of clinical fluid assessment, especially for patients with End Stage Kidney Disease on maintenance dialysis. Clinical components are designed for participants to go through an internship with a recommended mentor for practicing patient assessment*

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Introduction
This learning package is one of a suite of packages aimed at offering guided learning for nephrology nurses to further enhance their clinical skills and knowledge. Advanced fluid assessment package explores the principle of clinical fluid assessment, especially for patients with End Stage Kidney Disease on maintenance dialysis. Clinical components are designed for participants to go through an internship with a recommended mentor for practicing patient assessment

Disclaimer
This learning package has been prepared by health professionals employed in Hunter New England Local Health District in the Renal Services. While all care has been taken to ensure that the information is accurate at the time of development, the authors recommend that all information is thoroughly checked before use if utilised by another unit, context or organisation.

Naming Convention
Renal: Advanced Fluid Assessment

Aim
The aim of this package is to provide advanced fluid assessment skill and knowledge of the End Stage Kidney Disease patient that underpins the practice of nurses caring for patients on renal replacement therapy.

Learning Objectives
Following the completion of this learning package, the learner will be able to:

- Understand the normal mechanisms of fluid balance within the body
- Explain the changes to fluid balance regulation that occurs in renal disease
- Understand the physical changes and complications that occur in hypovolemia and hypervolemia in patients with Chronic Kidney Disease stage 4 and 5
- Understand all parts of clinical assessment including medical history, biochemistry findings, physical assessment and treatment review related to fluid assessment
- Consolidation of understanding of the principle of clinical assessment and its role in the nurses' dialysis care plan and/or prescription

Following the completion of the clinical assessment, the participant will be able to:

- Undertake a comprehensive fluid assessment correctly
- Evaluate the ideal body weight from clinical assessment

- Develop a treatment plan including recommendation for medication adjustment and ultrafiltration strategy to achieve target weight

Pre-requisites

Requirements undertaken prior to commencement of this self-directed learning package are:

- At least 12 months nephrology clinical experience.
- Completion "Anatomy and Physiology of Renal System" self-directed learning package
- Completion "Introduction to Haemodialysis" self-directed learning package or
- Completion "Peritoneal Dialysis" self-directed learning package

On completion and submission of this learning package a record of your completion will be added to your MyHealth Learning record.

Learning Package Outline

The package is designed to be a self-directed learning experience that will guide you through the literature and clinical issues related to advanced fluid assessment.
This package is developed within an adult learning framework so not all activities need to be documented but it is expected that you will complete them to facilitate your learning.

Instructions for participants

It is estimated it will take on average 10 hours to complete this package
Completion of this package is equivalent to Continuing Professional Development (CPD), hours which is a requirement for National Registration. Evidence of CPD can be generated using the reflection tool on learning at the end of the package.

Self-directed reading will be required to complete this package. Some activities will include essential reading and others will have additional supplementary readings that participants can undertake to further consolidate their knowledge.

A brief outline of the topic followed by recommended readings & learning activities that will reinforce key points guide participants study.

There is a suggested reference list but it is by no means complete. Please read widely to facilitate your learning. Journal articles can be accessed through CIAP. The online readings are not provided within this document due to copyright law restrictions. If you have any difficulty locating the readings please seek assistance from your relevant NE/CNE/CNS/CNC or hospital library.

<u>This SDLP uses the following icons</u>:

	**READING** **This icon alerts you to undertake reading related to the subject**

	**LEARNING ACTIVITY** **This icon denotes a learning activity that you will need to complete**

	**GUIDELINES** **This icon alerts you to the presence of a guideline or procedure related to the subject**

Assessment process
When completed, you can return the package to relevant NP/NE/CNE/CNC who will discuss it with you.

Reflection tool
At the completion of the Learning Package we have added a reflection form that will assist you in reflecting on the package and how it meets your professional development needs.

Evaluation
A form is included at the end of the learning package for your completion. All feedback is appreciated and assists in development of a quality program. Please return the completed evaluation form to your relevant NP/NE/CNE/CNC.

THE KIDNEY & FLUID BALANCE

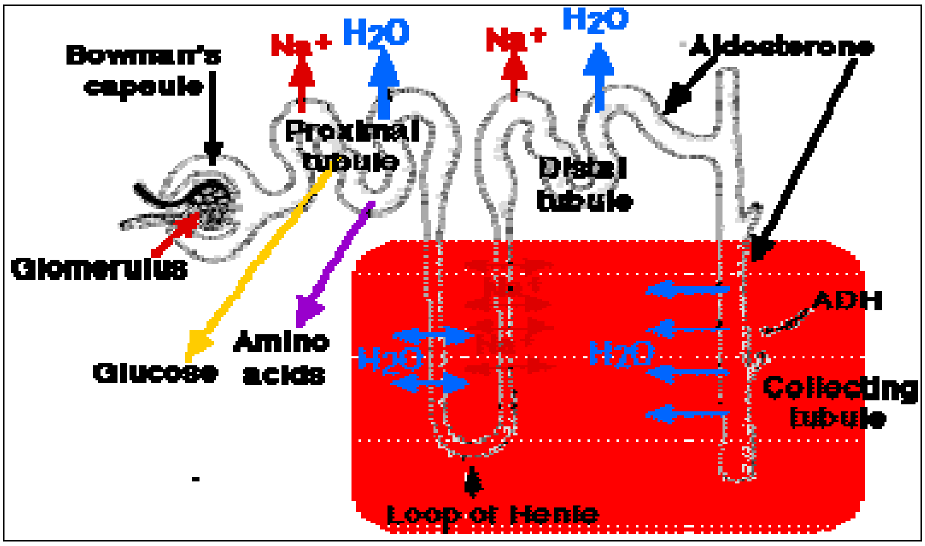
- *Understand the normal mechanisms of fluid balance within the body*
- *Explain the changes to fluid balance regulation that occurs in renal disease*

Whilst acknowledging kidney anatomy and physiology is one of the components in undergraduate study, it is crucial for participants to review and extend existing knowledge in this field to successfully complete this package.

The Kidneys

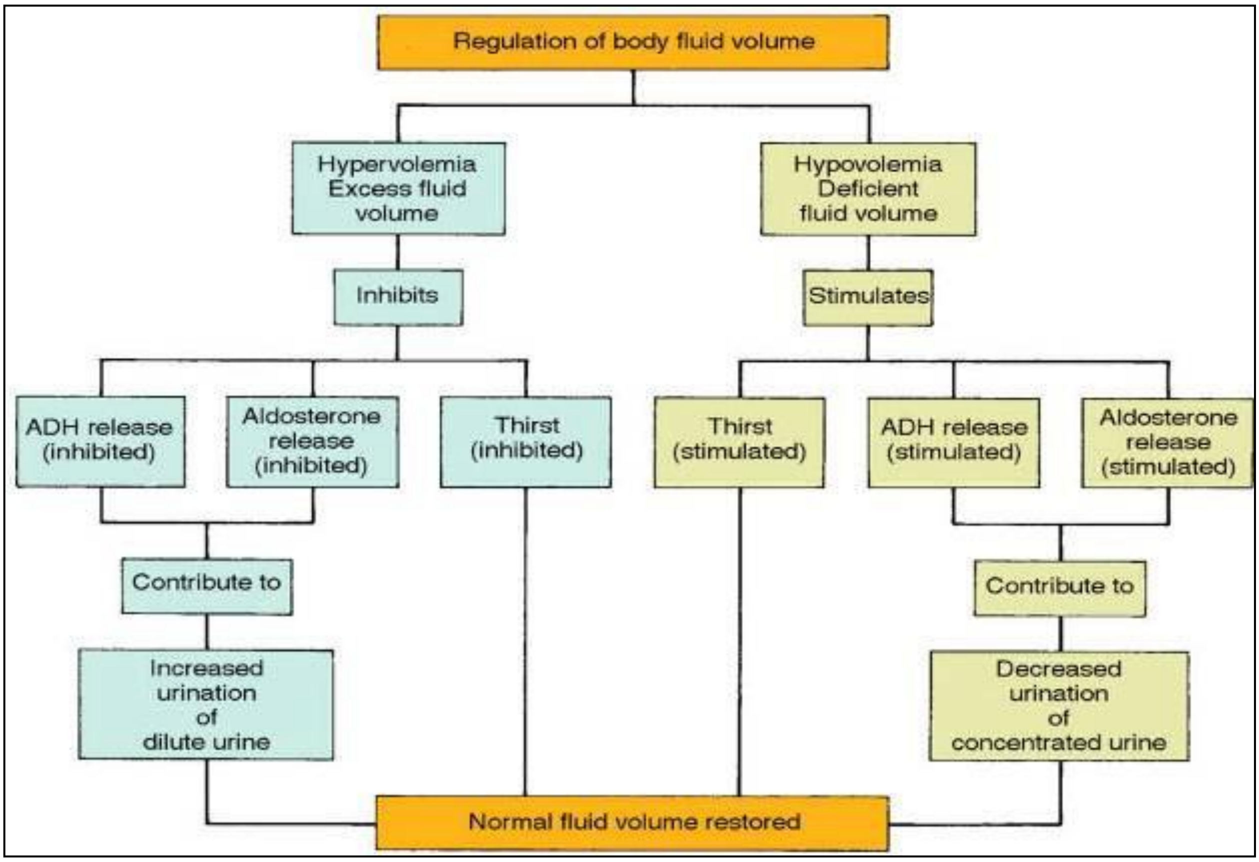
One of major roles of the Kidneys is to regulate body fluid by releasing or inhibiting antidiuretic hormone (ADH) to maintain balance of water and electrolytes. ADH receptors are found in the collecting ducts of the kidney. Healthy kidneys provide a negative-feedback loop for ADH secretion to control plasma osmolality (Thomas, 2014). Besides ADH, aldosterone and atrial natriuretic peptide are also hormones that affect sodium absorption and hence fluid volume. The following two diagrams provide an illustration of the relationship between those hormones in kidney function and water regulation.

(Diagram 1)



(Picture adapted from internet at: www.mrothery.co.uk/.../**Water**%20**regulation**%20in%20the%20**kidney**.ppt)

(Diagram 2)



Sodium is another contributing factor to the balance of fluid volume. Healthy kidneys are able to regulate sodium level by storage, or excretion in response to an excessive amount of sodium. High level of sodium will trigger reabsorption of water resulting in hypervolemia. Low sodium levels result in decreasing extracellular fluid volume (Thomas, 2014).

Body Fluid

The human body contains an average of 50-60% water. This may vary according to age, gender and percentage of body fat, e.g. males 60% and females 50%. Body fluid is stored in several areas, however predominately it is found in two broad compartments:

- Intracellular compartment (2/3 of total body fluid)
- Extracellular compartment (1/3 of total body fluid).

Extracellular fluid is also stored in several spaces including: intravascular, interstitial and transcellular areas (Counts 2008). Only fluid in the intravascular space can be removed during dialysis via ultrafiltration (Thomas 2014). The amount of fluid available for ultrafiltration also depends on the body's ability to refill this space with fluid from the interstitial compartment. The following chart illustrates how body fluid is distributed within different compartments.

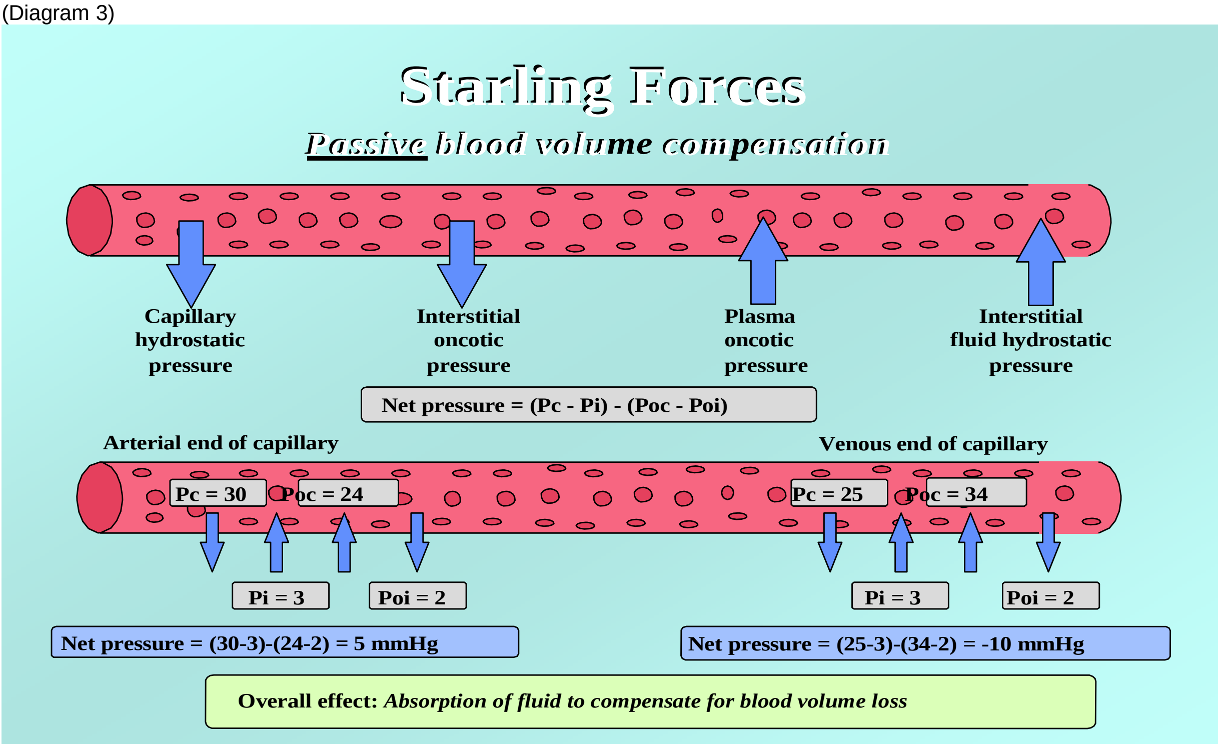
<u>Example of an average male adult of 70kg</u>

Total body Weight (TBW) = 70kgs Total body Fluids (TBF) = 60% of TBW = 42kgs (=42L)	Intracellular fluid (ICF) = 2/3 of TBF = approx: 28kg (=28L)	
	Extracellular fluid (ECF) = 1/3 of TBF = 14kgs (=14L)	Interstitial=3/4ECF=10kg(10L)
		Intravascular=1/4ECF= 4kg(4L)
		Trascellular= minimal approx: 1-2L

(Jaeger & Mehta ,1999; Koeppen & Stanton, 2017)

The body fluid moves freely between the compartments influenced by changes in hydrostatic and an oncotic pressure, known as “Starling Forces”. This is to maintain osmotic equilibrium (see Graph 3). Fluid distribution may also be affected by osmosis, diffusion, filtration and absorption.

(Diagram 3)



- Decrease in serum albumin
- Anaemia
- Heart Failure
- Increased capillary permeability
- Increased oncotic pressure in the interstitium due to accumulation of protein

Plasma refill rate is approximately 380mL/hr. This decreases in patients with ESKD and will further decrease during. Hypotensive episodes occur when the plasma refill rate does not match the rate of ultrafiltration. Clinical devices such as Blood Volume Monitoring (BVM) can be used as a tool to monitor patient's plasma refill during hemodialysis to anticipate intradialytic hypotension. The following readings are now required to obtain further depth of knowledge in fluid shift:

READING

1. Booth, J., Pinney, J., & Davenport, A. (2011). Do changes in relative blood volume monitoring correlate to hemodialysis-associated hypotension? Nephron Clinical Practice, 117(3), c179-c183.

2. Daugirdas, J. T. (2015). Measuring intradialytic hypotension to improve quality of care. Journal of the American Society of Nephrology, 26(3), 512-514.

3. Mahaldar, A. R. (2012). Acid base and fluid electrolyte disturbances in chronic kidney disease. *Clinical Queries: Nephrology*, *1*(4), 295-299.

LEARNING ACTIVITY

1. Please write a summary on a separate sheet of how CKD affects the water and electrolytes balance in the body.
2. A male patient weighing 80kgs, has a total body fluid of approx.:

   _______L; ICF approx.:________L; ECF approx.:_______mL

IDEAL BODY WEIGHT

- Understand the physical changes and complications that occur in hypovolemia and hypervolemia in patients with Chronic Kidney Disease stage 4 and 5

There are many terminologies used by clinicians when referring to "ideal body weight (IBW)", such as "target weight" or "ideal/dry weight". It is also difficult to find an agreed definition for ideal body weight in the literature. According to the most recent definition in the National Kidney Foundation KDOQI guidelines (2006) ideal body weight is referred to as:

"*A patient's dry weight usually determined clinically by evaluating level of blood pressure, evidence of fluid overload, and the patient's tolerance of ultrafiltration aimed to arrive at the estimated target weight.*" (Haemodialysis Adequacy: Guideline 5, pp 2)

Clinical methods that are used to assess IBW include: patient history, clinical signs, x-ray findings and laboratory results. Details are listed in the table below:

	Fluid overload	Fluid depletion
Patient History	Non-compliant with fluid intake	Unwell, lost appetite
	Increase salt intake	Vomiting& diarrhea
	Dyspnea	Dizziness
	headache	cramps
Clinical Signs	hypertension	hypotension
	No postural BP drop	Severe postural BP drop
	Increase in weight	Decrease in weight
	Skin-edema	Dry mucous membrane
	Headache	Muscle weakness
	Increase in Jugular Vein Pressure (JVP)	Flat Jugular Vein Pressure (JVP)
	Bounding pulse	Weak rapid pulse
X-ray	Pulmonary oedema	
Lab data	haemoconcentration	haemodilution

(Charra, B. 2007)

It is important to understand the signs and symptoms of fluid overload and depletion before starting a fluid assessment, so that an accurate interpretation of assessment findings can be achieved.

The following readings will provide more insight into the concept of IBW in dialysis patients and how it is measured clinically. While there is no standard measurement method, it is important to understand why some methods are commonly used by clinicians to ascertain patients' fluid status.

LEARNING ACTIVITY

3. Select a patient in your unit who has recently had his/her IBW reviewed by a clinician. Compare the patient's current weight and IBW to his/her clinical presentations and write down your comments on a separate sheet of paper.

READING

4. Miguel, S. (2010) Hemodialysis dry weight assessment: A literature review. Renal Society Australasia, 6(1), pp. 19-24.

5. Charra, B. (2007) Fluid Balance, dry weight, and blood pressure in dialysis. Haemodialysis International, 11, pp. 21-31.

6. Zhu, F., Rosales, L., & Kotanko, P. (2016). Techniques for assessing fluids status in patients with kidney disease. Current opinion in nephrology and hypertension, 25(6), 473-479.

FLUID ASSESSMENT

There are many different approaches used to conduct a fluid assessment. Some clinicians use a systematic approach; others may use a head to toe approach. To accurately assess a patient's IBW it is recommended that either approach incorporate patient history and physical assessment.

PATIENT HISTORY

- Consolidation of understanding of the principle of clinical assessment and its role in the nurses' dialysis care plan and/or prescription

Collecting patient history is the first and most important step when assessing the patient's fluid status. The examiner should have a clear idea on what they are looking for to generate appropriate patient questions. If you want to know whether a patient suffers from symptoms of fluid overload, ask direct questions, for example: Do you sleep flat? These answers will help to provide you with a general picture of the patient's overall wellbeing related to fluid status.

<u>The questions that you should be asking include</u>:

- <u>Perception of illness</u>: How much does the patient know about their illness, does the patient understand what "fluid & diet restriction implies", does the patient have the ability to follow instructions?
- <u>Present illness and current symptoms</u>: Does the patient look well, does the patient experience any symptoms of nausea/vomiting or diarrhea how is the patient's appetite, does the patient often feel thirst?
- <u>Past medical history</u>: Any cardiovascular disease, liver disease, neurological illness and if the illness is well managed?
- <u>Family and social history</u>: Is the patient independent, any access of services, has the patient or carer been provided with education or support?
- <u>Current medical and/or nursing management</u>: Are there any special care plans developed for the patient, any strategies or special regimes developed to manage the patient's illness?
- <u>Current medication</u>: Indications and potential side effects, has the prescription been reviewed recently, is the patient aware of any medication change or is the patient on a medication that affects blood pressure or fluid retention?

The examiner should have the knowledge to analyse findings related to fluid status and link these to other comorbidities suffered by the patient. For example, patients with congestive cardiac failure often present with breathlessness which can be misinterpreted as a symptom of fluid overload. Breathlessness could be also associated with anaemia, again not related to fluid status. Therefore, patient history should advise any assessment and guide further investigation and interpretation of laboratory results and physical assessment findings that you perform as part of the fluid assessment.

PHYSICAL ASSESSMENT

- Understand all parts of clinical assessment including medical history, biochemistry findings, physical assessment and treatment review related to fluid assessment

Physical examination can be performed at the same time when you interview the patient. The techniques used often include: inspection, palpation, percussion and auscultation. These techniques will provide you with insight into the patient's overall condition, and will identify areas that may need a more detailed investigation. The aim of the physical assessment is to identify fluid within the intravascular and extravascular space. It is important to differentiate this as the final ultrafiltration strategy and prescription only directly addresses intravascular fluid removal.

	**INSPECTION:** This technique will provide you with a general overview of the patient's condition and assist in making an informed decision. Use smell, hearing, sight and touch to perform a quick examination and observe any abnormalities. Review the patient's vital signs and make a summary of your finding. Skin colour - should be noted when performing an inspection, as cyanosis can indicate oxygen desaturation. Mucous membrane: The eyes and tongue can indicate the patient's general condition e.g. dry and furrowed tongue may indicate dehydration.

	**PALPATION:** Use deep bimanual pressure to assess oedema or tenderness. This technique can also be used to examine skin texture, moisture and temperature. Oedema - This is not always visible and palpable. Fluid can accumulate in a third space such as the lungs, abdominal cavity, face and neck area. Ethnicity can play a role as well as a patient's level of activity and should direct areas of assessment. For example, in non-mobile patients fluid would be more likely to accumulate around the back and buttock. Chest wall expansion - The patient should be in a sitting position leaning forward while the examiner's hands are placed equally on the posterior chest wall. When the patient inhales and exhales slowly, the examiner's hands should move apart equally around 3-5cm from the midline. Chest expansion will decrease when there is not enough movement through the lungs on respiration. Tactile Fremitus- A technique used to feel the vibration through the chest wall by asking a patient to say "99". When the intensity increases, it can indicate an obstructed airway or consolidation due to pneumonia, or pulmonary oedema.

	LEARNING ACTIVITY
	4. Make an appointment with NP or CNE to participate in a fluid assessment on a patient in your unit. Observe what methods are used in assessing a patient's fluid status. On a separate piece of paper write down some comments that will assist you in practicing fluid assessment in the future.

	READING
	7. Massey, D., & Meredith, T. (2010). Respiratory assessment 1: Why do it and how to do it? British Journal of Cardiac Nursing, 5(11), 537. 8. Meredith, T., & Massey, D. (2011). Respiratory assessment 2: More key skills to improve care. *British Journal of Cardiac Nursing*, *6*(2), 63.

1. Weight

Causes of weight gain can be attributed to fluid retention, gaining muscle mass or fat. Rapid weight changes in a short period of time are often related to fluid retention rather than nutritional causes therefore, regularly weighing the patient is the best and quickest way to review fluid status. Interdialytic weight gain (IDWG) is often expected to be 1- 4L depending on individual residual renal function and fluid/diet intake (Daugirdas, 2015).

Excessive interdialytic weight gain will result in higher ultrafiltration rates required during a haemodialysis treatment. This is a risk factor contributing to higher mortality and morbidity (Lindberg et al, 2009). It is important to educate patients on the appropriate fluid and salt intake.

Although weight is the most common method used in the clinical setting when performing an IBW assessment, it should never be used in isolation.

2. Blood Pressure

Blood pressure is determined by cardiac output and peripheral resistance. In a healthy adult, we can see blood pressure rise when there is an increase of fluid volume; therefore clinically hypertension is often interpreted as a sign of fluid overload in this situation. However, patients with ESKD have other co-morbidities that can affect blood pressure response. This and patient medication should be considered when assessing the patient's fluid status.

It is important to ensure correct methods are applied when obtaining blood pressure. A manual blood pressure and heart rate should be attended as part of the fluid assessment. Ensure selection of an appropriate cuff size and when required to perform a blood pressure on a thigh or calf the patient should be in a lying position. It is recommended the patient is positioned with arms and/or feet supported at heart level before taking a blood pressure.

A blood pressure should be measured in a lying or sitting and standing position to assist in ascertaining a patient's fluid status. Orthostatic hypotension often indicates volume depletion however, if blood pressure rises when standing, it can indicate fluid overload (Counts, 2008).

Hypertension is prevalent among renal patients, and is a major contributor to left ventricle hypertrophy and cardiac failure. It is important to maintain a patient's blood pressure according to accepted guidelines however, it can vary depending on the individual patient's medical history, current use of medication and dietary intake.

READING

9. Chazot, C. (2009) Managing dry weight and hyterpention in dialysis patients: still a challenge for the nephrologist in 2009? *JN*, 22, pp. 587-597

10. Chobanian, A, Bakris, G, Black, H, Cushman, W, Green, L, Izzo, J Jr, Jones, D, Materson, B, Oparil, S, Wright, Roccella, E Jr, & the National High Blood Pressure Education Program Coordinating Committee (2003) "Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of high blood pressure", Journal of The American Heart Association, vol. 42, pp. 1206-1252, viewed 5 October 2010, <http://hyper.ahajournals.org/cgi/content/full/42/6/1206>

11. Lindberg, M, Prutz, K, Lindberg, P & Wikstorm, B (2009) Interdialytic gain and ultrafiltration rate in hemodialysis : Lessons about fluid adherence from national registry of clinical practice. *Hemodialysis International*, 13, pp. 181-188.

LEARNING ACTIVITY

5. What are the common antihypertensive medications that your patients have been prescribed and will they be affected by haemodialysis?

6. What is the definition of hypertension? Is it different in dialysis patients? What is the therapeutic aim for pre dialysis and post dialysis blood pressure? Is the therapeutic aim different in CKD patients who also have diabetes and microalbuminuria? If so, what should the level be?

3. Oedema

Oedema is a simple term describing excess fluid in the tissue. A presence of oedema is often interpreted as fluid overload (Court, 2008). However, clinicians need to be mindful that oedema can be attributed to medical conditions, co-morbidities and medications as well as a patient's fluid status

In the early stage of kidney disease, sodium retention, hypertension and a decreased protein level are major causes of oedema. Excessive sodium due to worsening renal function will attract water via osmosis and cause oedema. During ESKD, oedema is often the result of fluid overload (Daugridas & Ing, 2015).

According to Starling Forces, venous blood pressure being lower than arterial blood pressure creates a stable capillary hydrostatic pressure that is balanced with colloid osmotic pressure to maintain a stable fluid status in interstitial spaces.

When venous blood pressure increases, e.g. obstruction or congestive cardiac failure or fluid overload, capillary hydrostatic pressure rises. This results in less absorption than ultrafiltration via the capillary wall causing oedema in interstitial spaces (Koeppen & Stanton, 2017).

Low albumin also contributes to oedema. This is often seen in renal patients due to protein loss in urine or peritoneal dialysis. This reduces colloid pressure leading to interstitial oedema. The readings will provide a description of movement of solutes and water and the causes of oedema (Schwartzstein, 2014).

READING

12. Koo, L., Reedy, S. & Smith, J. (2010) Patient history key to diagnosing peripheral edema, *The Nurse Practitioner*, Vol 35, No. 3, pp.44-52

LEARNING ACTIVITY

7. Please explain the cause of oedema in renal patients.

8. Select a patient who shows signs of oedema. Review history & clinical manifestations. List findings i.e. cause and type of oedema, treatment & assessment. At home access U-Tube and find lung sounds and become familiar with the types

<u>Pulmonary Oedema</u>
The most common and fatal oedema in renal patients is acute pulmonary oedema, causing respiratory distress and death if adequate intervention is not provided. The cause of pulmonary oedema can be categorised into two areas: cardiogenic and non-cardiogenic pulmonary oedema.

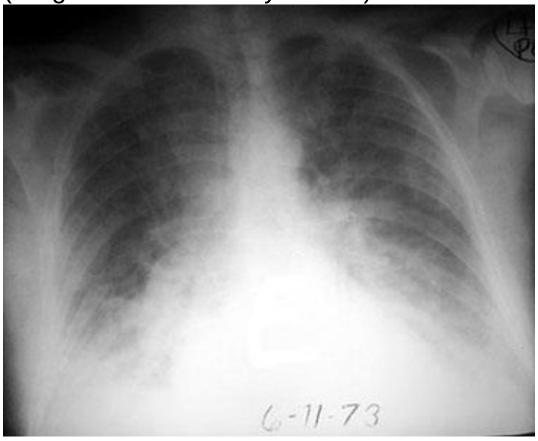
<u>Cardiogenic pulmonary oedema</u> results from left ventricular failure. This condition is caused by an accumulation of blood in the left ventricle resulting in a back pressure into the pulmonary system.

<u>Non-Cardiogenic pulmonary</u> oedema results from increased capillary permeability, often seen in patients with acute lung injuries or acute respiratory distress syndrome.

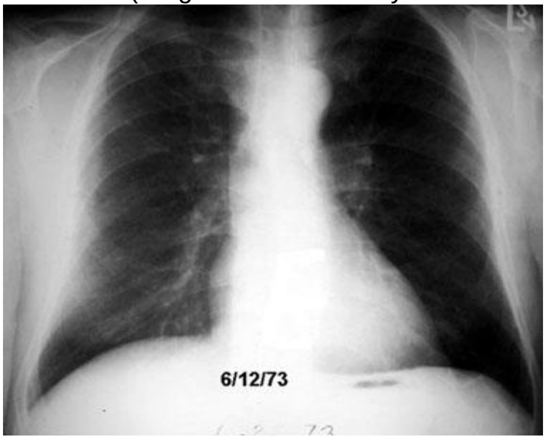
Renal patients are often associated with cardiogenic pulmonary edema due to worsening kidney function resulting in fluid retention and hypertension, which are the major contributors to left ventricle hypertrophy and pulmonary oedema (Schwartzstein, 2014).

Chest x-ray is a common method used in conjunction with other physical examinations to identify stages of pulmonary oedema. On x-ray normal lung field is seen as a dark colour representing the absence of fluid. Fluid filled lung fields are seen as a shadowed appearance. Other signs and symptoms include: breathlessness, hypoxia, frothy sputum, hypertension and heart murmurs.

(Diagram 4: Pulmonary edema)



(Diagram 5: Pulmonary edema–resolved)



The following readings provide further details of causes, assessment and treatment options for pulmonary oedema.

READING

13. Messerli, F. H., Bangalore, S., Makani, H., Rimoldi, S. F., Allemann, Y., White, C. J., .& Sleight, P. (2011). Flash pulmonary oedema and bilateral renal artery stenosis: the Pickering syndrome. European heart journal, 32(18), 2231-2235.

14. Sovari, A, Kocheril, A & Baas, A (2008) Pulmonary Edema, Cardiogenic, eMedicine, viewed 11 October 2010, http://emedicine.medscape.com/article/157452-overview>

LEARNING ACTIVITY

9. What are the signs and symptoms of acute pulmonary oedema?

   ____

   ____

   ____

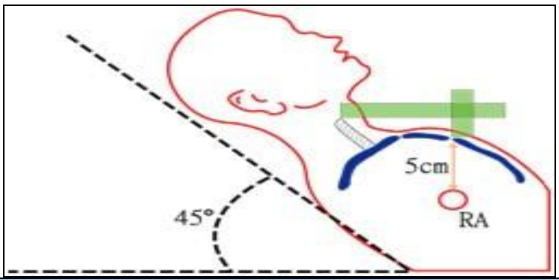
   ____

10. Again at home access U-Tube lung sounds and become familiar with the Various types.

3. Jugular Venous Pressure

Jugular venous pressure (JVP) is used clinically to assist in diagnosing a patient's cardiac function and fluid status. The jugular vein reflects pressure changes within the right atrium. The correct way of measuring JVP is to elevate the patient's head at the angle of 45 degrees (Diagram 6) and adding 5 cm from the sternal angle for patients with venous pressure of zero (in the normovolemic patient). If the highest pulsation of the JVP is higher than 5 cm, it often indicates increased right atrium pressure and fluid overload (Chiaco, Parikh, & Fergusson, 2013).

(Diagram 6)



LEARNING ACTIVITY

11. Please identify at least two causes of elevated JVP and give an explanation as to why this is commonly found in the renal patient.

____

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____

____

READING

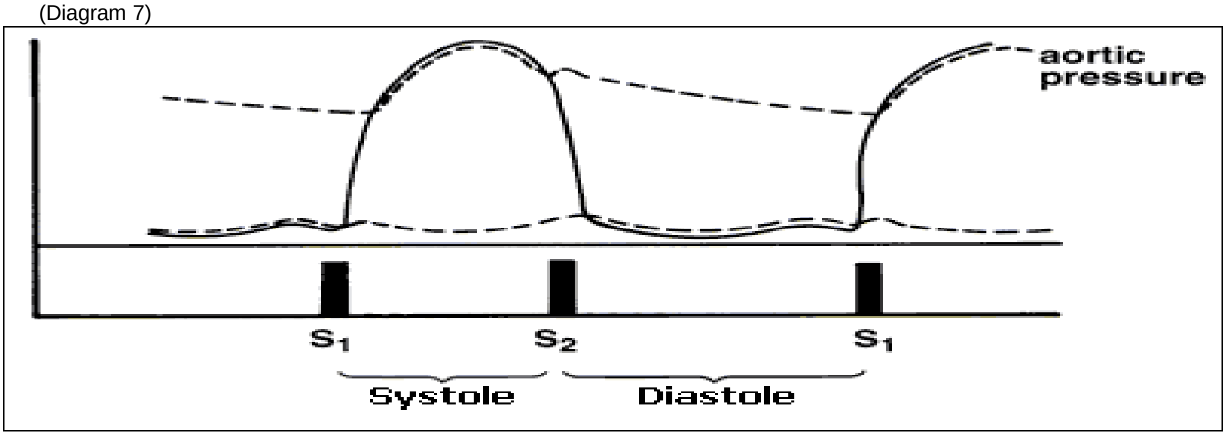
15. Chiaco, J. M. S. C., Parikh, N. I., & Fergusson, D. J. (2013). The jugular venous pressure revisited. Cleveland Clinic journal of medicine, 80(10), 638.

4. Heart Sounds

Heart sounds are the result of blood flow travelling through the heart. The heart sounds can be heard in two distinct sounds: S1 & S2 through auscultation. The additional heart sounds S3 and S4 will occur in patients with fluid overload, hypertension and increased ventricular preload.

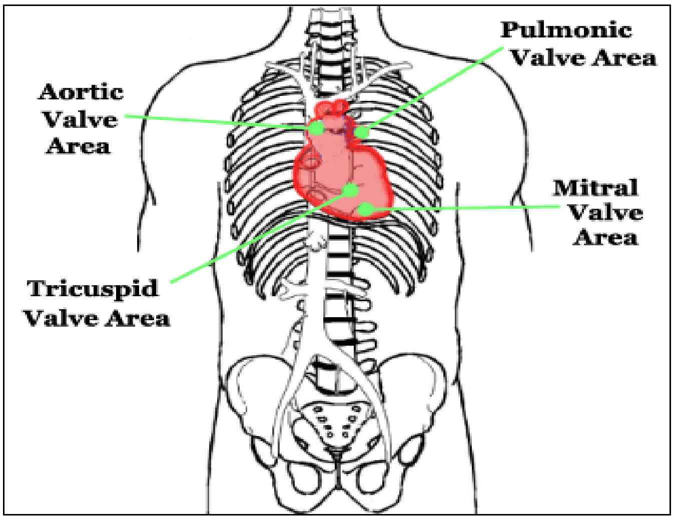
- S1 Dull low pitch, loudest at apex, heard at the beginning of systole
- S2 Heard at the start of diastole with a shorter and higher pitch than S1.
- S3 Ventricular gallop and results from rapid blood flow into the ventricles due to increased preload such as hypertension or fluid overload.
- S4 Atrial diastolic gallop and is a result of a resistance to ventricular filling due to hypertension or left ventricle stiffness.

(Diagram 7)

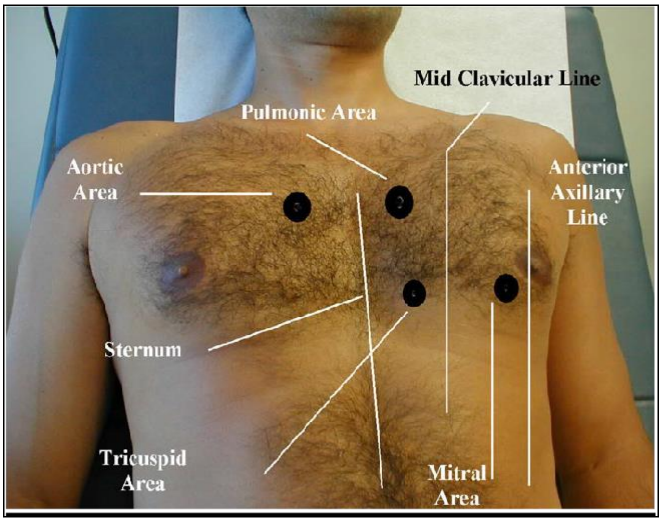


Auscultation of heart sounds is important in ESKD patients as AV murmurs often present in patients with intravascular fluid overload and may ease once fluid has been removed during a dialysis treatment. It is recommended when performing auscultation, to listen to all areas including aortic, pulmonary, tricuspid and mitral areas (see graph 9) to differentiate each sound and the different pitch. Patients are encouraged to be in a supine position with head slightly elevated. Examine from the patient's right side and work your way across and down. Diagram 8 provides you with an overview picture of where you should place your stethoscope in each area. Generally, the aortic area is located at the patient's right side on the 2nd intercostal space near the sternum, while the pulmonic area can be found on the same level of the patient's left side.

(Diagram 8)



(Diagram 9)



LEARNING ACTIVITY

12. Select a patient who appears to be fluid overloaded and try to listen to his/her heart sound before dialysis, half an hour into dialysis and at the end of treatment as this is the best way to practice auscultation of heart murmurs.

13. Please take the opportunity to listen to the heart and lung sounds of your patients and become familiar with the various types. Discuss this with your assessor. At home U-Tube heart sounds and become familiar with the various types

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BIOCHEMICAL ASSESSMENT

- Understand all parts of clinical assessment including medical history, biochemistry findings, physical assessment and treatment review related to fluid assessment

Biochemistry and haemotological assessments play an important role in fluid assessment as they can provide insightful information on:

- The patient's intravascular fluid status
- Starling Forces: how fluid moves between the intravascular and extravascular spaces during ultrafiltration
- Assist in planning an ultrafiltration strategy and dialysis plan
- Differentiate symptoms that are related to fluid status or other chronic diseases.

Sodium, Chloride, Albumin and Haemoglobin are essential elements to investigate when reviewing a patient's laboratory data. Sodium and Chloride provide a good indication of a patient's fluid status and generally the level will decrease when the patient is fluid overloaded, this is due to haemodilution, and vice versa. For example you may see the patient's Sodium and Chloride levels increase when intravascular volumes are depleted and decrease when fluid overloaded.

Albumin gives information in relation to Starling Forces which is an important principle to understand in regards to fluid movement between different body compartments. Low albumin will result in reduced plasma colloid pressure. This pressure controls plasma refill from the extravascular space into the intravascular space. When this pressure is reduced interstitial oedema occurs.

For renal patients, there are many factors that will cause albumin decrease, examples being malnutrition, poor diet or loss of albumin within the urine (proteinuria) or peritoneal dialysis. It is therefore, extremely important for clinicians when performing fluid assessment, to check the patient's albumin level before determining dialysis options or ultrafiltration strategies.

Haemoglobin level can provide additional information for clinicians in response to the symptom of dyspnoea. Dyspnoea is a common symptom associated with fluid overload, and is also common in patients with anaemia or chronic airway disease. Therefore, clinicians need to consider the patient's co-morbidity and review the Hb level when making a treatment plan for dyspnoea.

MEDICATION

- Understand all parts of clinical assessment including medical history, biochemistry findings, physical assessment and treatment review related to fluid assessment

Many medications can mask blood pressure response to fluid overload or fluid depletion and some may also cause a postural blood pressure drop that is often misinterpreted as fluid depletion.

Medication such as antihypertensive, cardiac medication or diuretics can have a significant impact on fluid shift which, may result in intra or post dialytic hypotension. A postural blood pressure drop is commonly seen in patients who are prescribed Alpha adrenergic blocking agents such as prazosin, while some calcium channel blockers such a amlodipine can potentially cause oedema and are not easily removed from hemodialysis. Vasodilators such as minoxidil and hydralazine can also produce side effects such as oedema. (Kauric-Klein, 2015)

Therefore, it is important for clinicians when reviewing the patient's fluid status, dialysis prescription or tolerance to ultrafiltration, to review the patient's current medication(s) and their effects rather than rely on blood pressure response alone.

LEARNING ACTIVITY

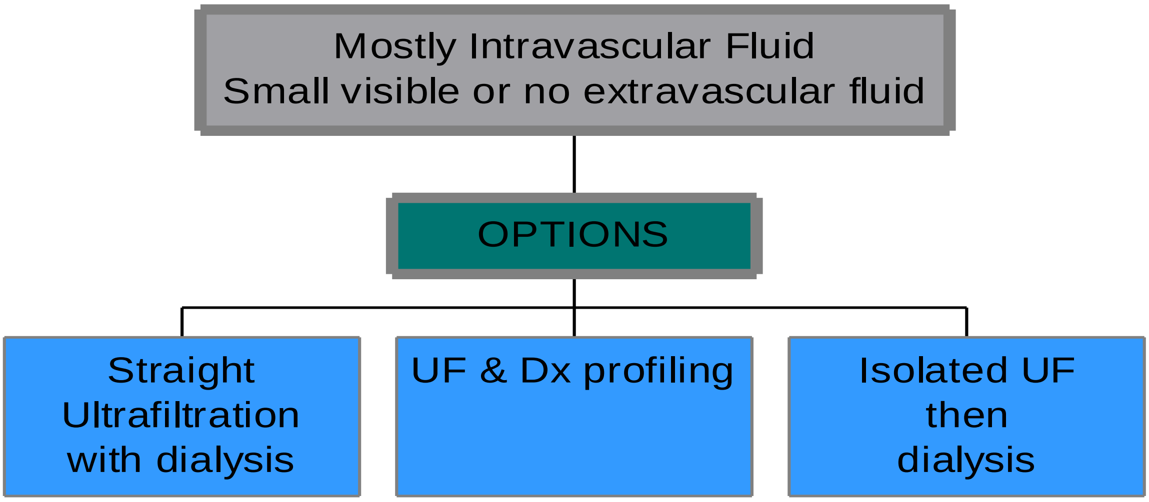
14. Review 4 medication charts & list common medications prescribed for ESKD patients. Indicate which medication is to be considered when performing a fluid assessment and why.

PUTTING IT ALL TOGETHER

Fluid assessment is the evaluation of all findings. To put all findings together, the clinician needs to be clear on what findings are related to intravascular fluid and those related to extravascular fluid volume. For example, combining the findings of JVP, heart sounds and laboratory data (e.g. sodium & chloride) should give you a good picture on the patient's intravascular fluid volume, while oedema (Albumin) and lung sounds are the indicators for extravascular fluid volume. The following graphs are extracted from Salem, Hayes & Harvie, 2008 fluid assessment PowerPoint presentation on how to summarise the investigations and put everything together to evaluate the patient's renal replacement therapy treatment. Although the graphs assist clinicians in determining ultrafiltration and / or dialysis strategies, nurses should also consider other forms of fluid management that may assist blood return or plasma refilling For example: Feet elevation and TED stockings will increase peripheral blood pressure and assist blood return, minimising the amount of food consumed during dialysis, adjusting dialysate temperature and sodium profiling can assist with plasma refill.

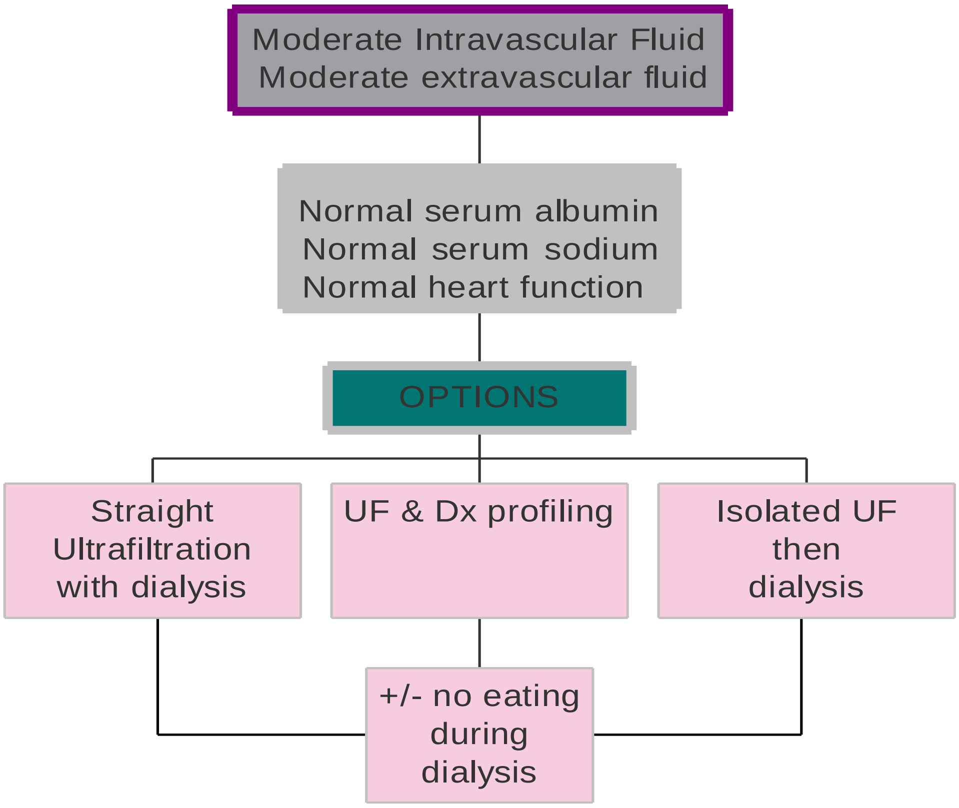
(Diagram 10)

FLUID GEOGRAPHY



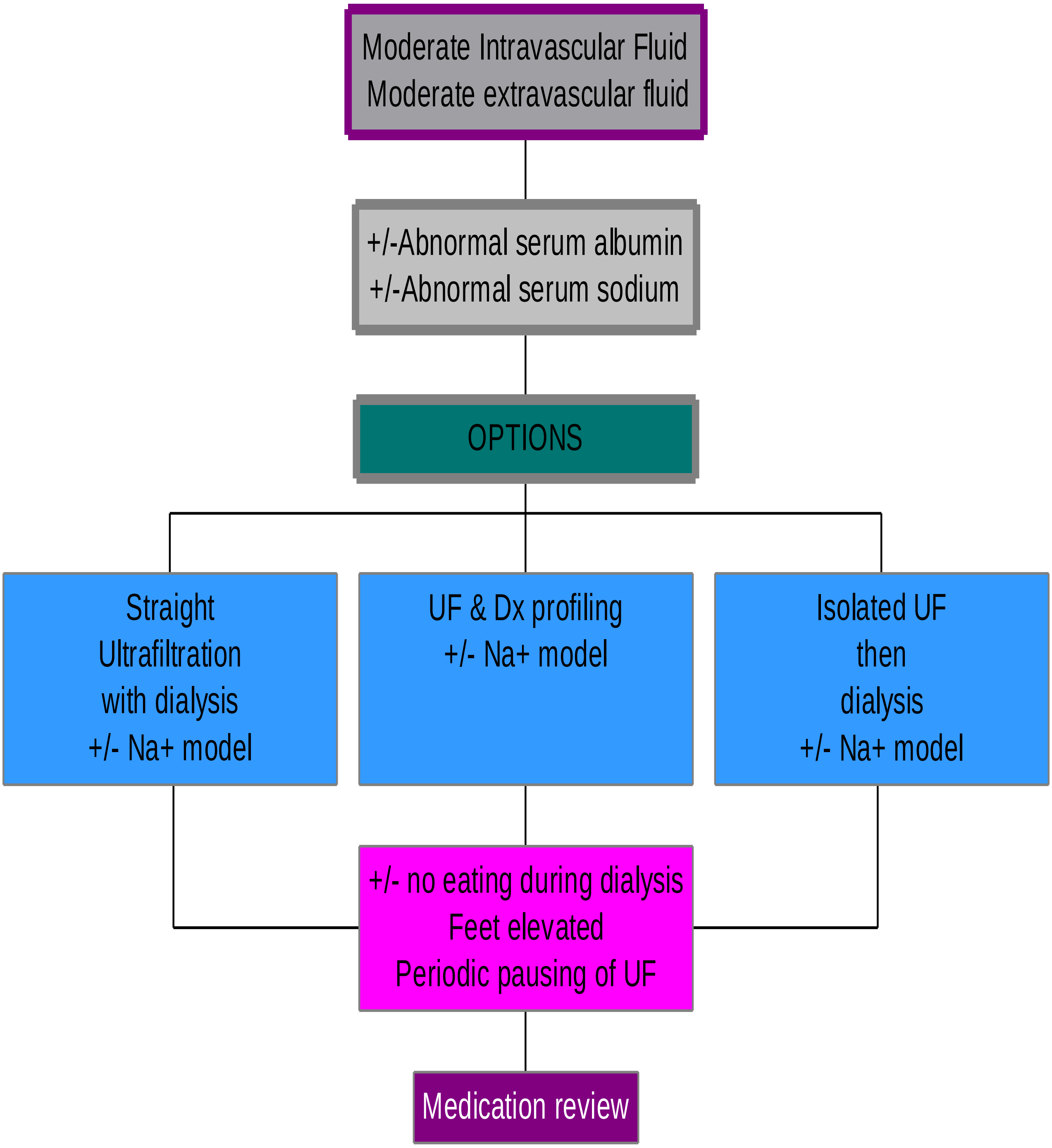
(Diagram 11)

FLUID GEOGRAPHY



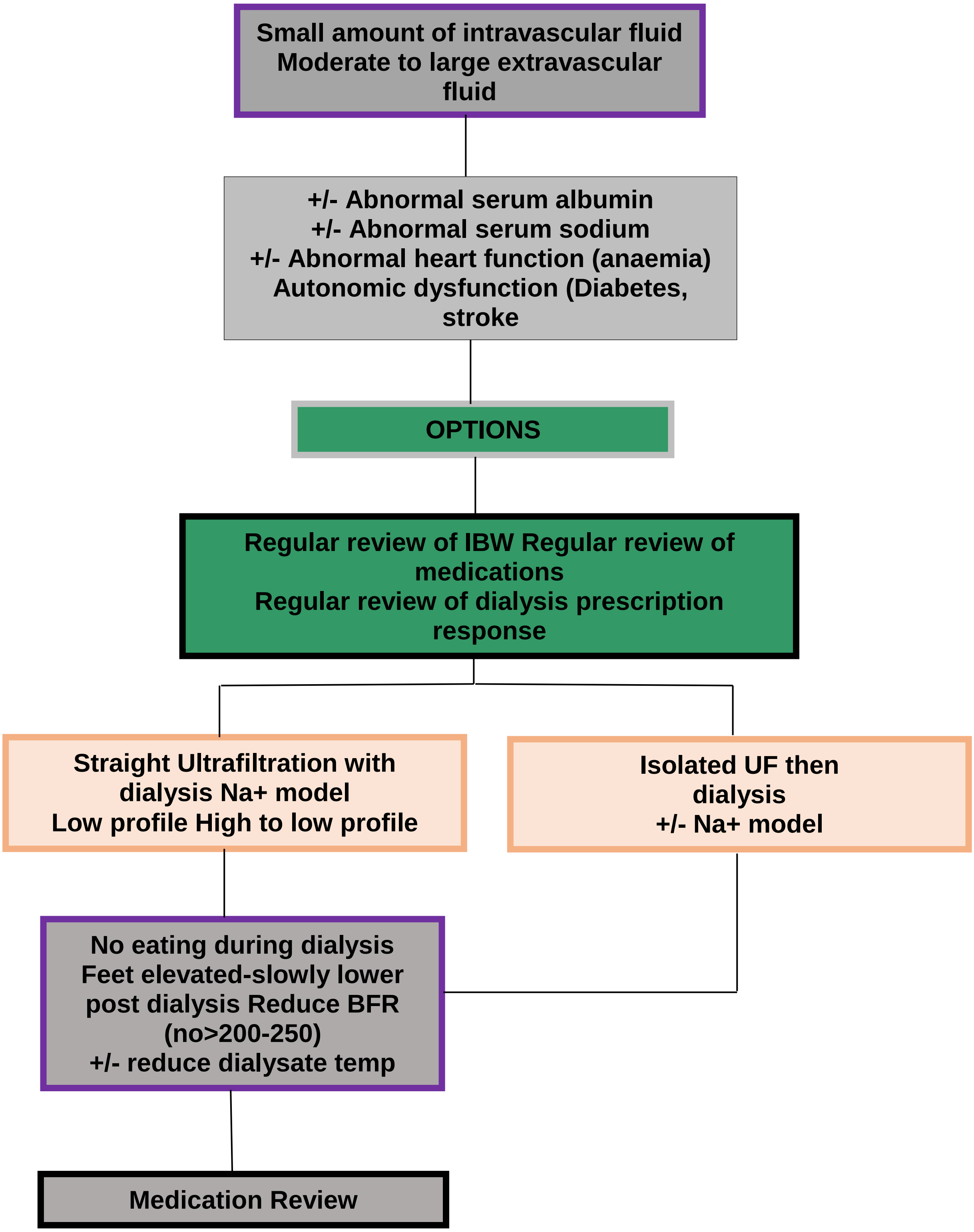
(Diagram 12)

FLUID GEOGRAPHY



(Diagram 13)

FLUID GEOGRAPHY



ADDITIONAL ASSESSMENT RESOURCES

Blood Volume Monitoring

As with all tools patient parameters and the disease process will impact on their effectiveness. For example the Blood Volume Monitor (BVM) may not be accurate if the patient has complex cardiovascular illness that effects plasma refilling. However, clinical monitoring of blood volume during dialysis has been evident in many studies to provide a good indication in assessing patients' ideal weight. Findings have also demonstrated, that a lack of significant change in blood volume during haemodialysis can indicate that the patient's pre-dialysis weight is too high (Dasselaar, Van der Sande & Franssen, 2012).

BVM uses an ultrasonic technique based on the principle of how sound travels through density, monitoring the changes in haematocrit (Hct) and Haemoglobin (Hb) during haemodialysis. It is understood that sound travels faster in a higher density environment (Daugirdas, Blake & Ing 5th ed, 2015). Blood density is dependent on the proportion of red blood cells and proteins contained within it. This proportion does not change during ultrafiltration, but rather the blood plasma becomes denser as fluid decreases. The relative blood volume (RBV) is used by the BVM device to reflect these blood volume changes and the plasma refill rate. These are then able to be interpreted and used as an indicator for an individual ultrafiltration rate to prevent excessive fluid removal and assist in the establishment of an IBW. Zhu, Rosales & Kotanko (2016) point out that RBV is influenced by ultrafiltration rates and the patients individual refill capacity/rate. This means a patient's vascular refill status is not always indicative of fluid overload.

Biochemical markers

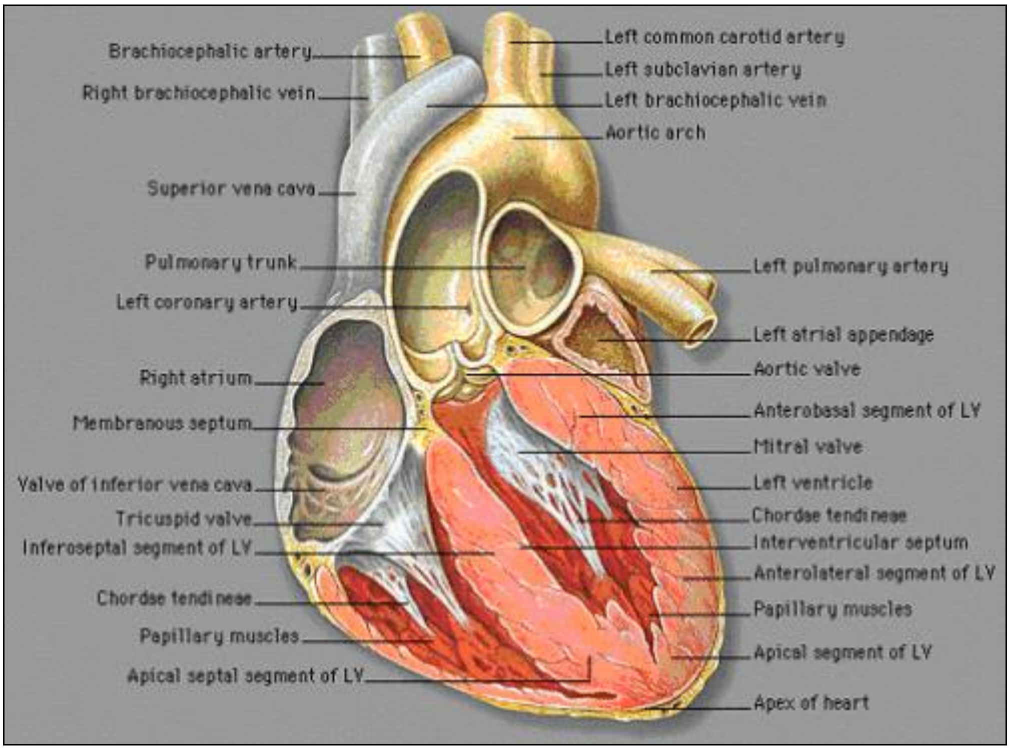
The most recognised biochemical markers for assessing venous intravascular volume are ANP, BNP and cGMP that are produced in atrial tissue in response to the heart being stretched due to increased pressure or fluid overload (Zhu, Rosales & Kotanko, 2016) .Atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP) are cardiac enzymes that will be released when ventricular walls of the heart are stretched. Cyclic guanosine monophosphate (cGMP) is the messenger for ANP and BNP and cGMP levels will increase when ANP and BNP are rising (Charra, 2007).

These biochemical markers may be beneficial in managing patients with Congestive Heart Failure (CHF). However in renal patients their function is of minimal use. They may eventually play a role in complementing data for the assessment of left ventricular dysfunction but at this time they are not commonly used as a part of IBW assessment in the clinical setting (Mark, Petrie, & Jardine, 2007).

Vena Cava Diameter

The inferior vena cava is the large vein that carries de-oxygenated blood from the lower half of the body, while the superior vena cava carries blood from the upper half of the body, both empting into the right atrium (see Graph 15). The inferior vena cava diameter (IVCD) can be used to measure intravascular volume, as it correlates well with central venous pressure. Clinical benefits of IVCD are its simplicity and noninvasiveness, as the procedure is done via an echocardiograph. During the procedure the clinician measures the inferior vena cava diameter during inspiration and expiration (Charra, 2007). However, limitations of the method are, accuracy in the presence of right sided heart failure and cost which effects the usefulness in a clinical setting (Miguel, 2010).

(Diagram 14)



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Extravascular lung water index (ELWI)

Extravascular lung water index (ELWI) has been proven to be a useful tool due to increased accuracy when compared with biochemical makers and IVCD. The procedure requires the patient to have an arterial access used as a measurement catheter. This catheter monitors changes and blood temperature by using a thermal dilution technique and PiCCO (Pulse Contour Cardiac Output) system to reflect the water content of lung tissue. Even though the study shows ELWI is a reliable method to assess the patient's fluid status, it is not practiced widely in the dialysis unit as it involves an invasive procedure that requires the patient to be admitted to hospital (Vitturi, Dugo, Soattin, Simoni, Maresca, Zagatti, & Maresca, 2014).

Bioelectrical Impedance Analysis (BIA)

This technique involves charging small electric currents (normally 50kHz) via electrodes that are applied to the patient's arms and legs. This technique works on the principle of electronic currents running freely through the parts of body containing fluid but demonstrating resistance when passing through fat tissue. The patient's total body water (TBW) is then calculated by using Lukaski & Bolonchuk's formula (adapted from http://www.brianmac.co.uk/fatbia.htm):

$TBW = 0.372(S^2 \div R) + 3.05(Sex) + 0.142(W) - 0.069(age)$

- S = Height in centimetres
- R = Resistance
- W = Weight in Kg
- Sex Male =1 Female = 0
- Age in years

Compared with other methods, this technique seems to be able to provide more promising data as it can measure not only intravascular fluid volume but also extravascular fluid volume (Yılmaz, Yıldırım, Aydın, Aydın, Kadiroğlu, Yılmaz, & Acet, 2014). However, the practicality of implementing this method in a clinical setting may be minimised as it can only be conducted at either the start or the end of dialysis session. Moreover, according to Miguel (2010) the reliability of using this method to assess the patient's IBW still requires a larger clinical randomised study to prove its benefit.

LEARNING ACTIVITY

15. What clinical technology can you use to monitor patient's plasma refilling rate during dialysis? Is it sufficient to rely on technology alone to prevent intradialytic hypotension? If not, what other interventions can you use to monitor a patient's fluid status?

16. From the clinical assessment methods available which methods are used in your clinical area? Please review why some methods are used more than others and why some methods are not used at all in a clinical setting. You may want to draw a table to compare each alternative assessment method and advantages and disadvantages to assist your understanding.

ADDITIONAL ASSESSMENT RESOURCES

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Learning Package: Reflection on Learning

This document guides your reflection on the extent to which the package meets your professional development needs, and how you plan to apply your learning into practice. This tool is not part of the assessment process, and has been included as a document that you may wish to include in your professional portfolio. Time taken to complete learning package: ____________

What was your purpose in completing this learning package?

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Did you achieve this by completing the learning package?

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Reflecting on the content, what key learning have you obtained?

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What learning will you apply to your practice immediately? How will you do this?

What learning needs have you identified as a result of completing this learning package?

How do you plan to address these needs?

Signature: ____________________________ Date: _____________________________

Learning Package Evaluation Form

Your feedback regarding this learning package is important to ensure the package meets your learning needs. Please take 5 minutes to answer the following questions to facilitate any change required for future learning packages

1. The learning outcomes of the learning package were clearly identified	Yes	No
2. The learning outcomes of the package were appropriate	Yes	No
3. The content provided enabled me to meet the learning outcomes?	Yes	No
4.The activities motivated my interest in the topic	Yes	No
5.The activities and workbook questions supported my understanding of the topic	Yes	No
6.The package was presented in a logical manner	Yes	No
7.The assessment process related to this package was clearly outlined (if applicable)	Yes	No

8. My most relevant learning outcomes from this package were: ______________________

____

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9. The key learning points from this package I can immediately apply to practice were:

____

____

10. The least relevant component(s) of this package were: _________________________

____

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11. Some suggestions I would like made to improve the package would be: ____________

____

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Thank you for your time to complete the evaluation

Please return to: The relevant CNE/NE/Renal Options Co-ordinator/CNC within your area.