Review of Literature
REVIEW OF LITERATURE

History of Hemodialysis:

1. The idea of removing solutes from body fluid by dialysis date back to beginning of 20th century.

2. The first experimental hemodialysis in dogs was performed by Abel et al at the Jhon's Hopkin Medical school in Baltimore.

3. The first hemodialysis was preformed by Georg Hass from Gieben Germany. He dialysed four patient with terminal renal failure between 1924 and 1928.

4. Haas found in 1925 that technical and anticoagulation problem limited the treatment and patient died from temporary improvement in uraemic condition.

5. Willen kolff at Groninger University Hospital in the Neitherland introduced the first dialyser suitable for human use in 1943.
6. The first patient whose life was saved by treatment with artificial Kidnécy was a woman with ARF.

7. In 1960 the arterio-venous cannula system was introduced as a vascular access for hemodialysis by Belding.

8. In 1966 scriloner created A.V. fistula.

**INTRADIALYSIS HYPOTENSION**

Common causes of hypotension.

1. Related to excessive decrease in blood volume.
   
   (i) Fluctuation in Ultrafiltration rate.
   
   (ii) High Filtration rate.
   
   (iii) Dialysis solution have low sodium.

2. Related to lack of vasoconstriction
   
   (i) Antihypertension medication.
   
   (ii) Accetate containing dialysis solution.
   
   (iii) Dialysis solution that in relatively too warm.

3. Cardiac Cause
Failure to increase cardiac rate under condition of decrease filling.

1. Aging
2. Uremic autonomic neuropathy
3. MI
4. Septicemia
5. Pericardial tamponade
6. Occult Hemorrhage.
7. Arrhythmias.


### Age (Years)

<table>
<thead>
<tr>
<th>Number of treatment</th>
<th>&lt;30</th>
<th>30-50</th>
<th>51-70</th>
<th>&gt;70</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1314</td>
<td>5355</td>
<td>11085</td>
<td>4800</td>
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</table>

Percentage of treatment with

<table>
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<tr>
<th></th>
<th>&lt;30</th>
<th>30-50</th>
<th>51-70</th>
<th>&gt;70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hypotension</td>
<td>18.1</td>
<td>19.7</td>
<td>25.2</td>
<td>34.0</td>
</tr>
<tr>
<td>2. Nausea</td>
<td>8.0</td>
<td>6.8</td>
<td>8.1</td>
<td>8.8</td>
</tr>
<tr>
<td>3. Vomiting</td>
<td>3.4</td>
<td>2.3</td>
<td>3.7</td>
<td>6.2</td>
</tr>
<tr>
<td>4. Cramps</td>
<td>11.4</td>
<td>13.3</td>
<td>10.2</td>
<td>6.7</td>
</tr>
<tr>
<td>5. Chest pain</td>
<td>0.9</td>
<td>1.2</td>
<td>1.5</td>
<td>1.3</td>
</tr>
<tr>
<td>6. Fever</td>
<td>0.6</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1</td>
</tr>
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</table>

2. Study done by same

Number of treatment associated with Hypotension and number of Hypotension requiring intervention.

<table>
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<tr>
<th>Number of treatment</th>
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<th>11085</th>
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<td>17.3</td>
<td>21.7</td>
</tr>
</tbody>
</table>
• Acetate used in dialysis units has vasudialator effect- causing hypotension. Pagel MD, Ahmads, Vizzo Je, Scribner BH, Acitate and bicarbonate, fluctuation and acetate intolerance during dialysis. Kidney Int. 1982, 513-518.

• Lowering dialysate temperature has been reported to decrease the number and severity of hypotensive episode in dialysis patients.


**INTRADIALYTIC HYPERTENSION**

*Causes of intradialytic hypertension*

1. Pre-existing hypertension

2. Volume overload

3. Increase alpha sympathetic activity.

4. Hypercalcemia - increase inotropy and vascular tone.
5. Increase Hct - increase blood viscosity - increase peripheral resistance.

6. Reversal of hypoxia induced vasodilation.

7. Hypokalemia / volume depletion - increase renin angiotensin.

- A minority of patient (10%-30%) experience rising blood pressure which can sometimes be dramatic over course of dialysis-Rosa AA, Fiyd D.S., Kjellstrand CM: Dialysis symptoms and stabilization in long term dialysis: Practical application of sum plot Arch Intern Med 1980 140:804-807.


- Rising ionised calcium level increase myocardial contractility, left ventricular stroke volume and cardiac output. Increase peripheral vascular resistance
Fellner SK., intradialytic hypertension II
Semin Dial 1993 371-373.

**Cardiac Arrhythmias both atrial and ventricular**

The near absence of arrhythmias is paediatric dialysis population and low prevalence in adults without coronary artery disease or LVH indicates dialysis treatment per se is not arrhythmogenic.

Contributing factors to intra dialytic arrhythmias include LVH (especially in presence of digitalis), CAD, Hypokalemia.

- Eighty percent of recorded sudden deaths in intradialytic period are due to ventricular fibrillation Chazan J. Sudden deaths in patients with CRF on hemodialysis , Dial transplant 1987 447-448.

- Dialysis treatment with fluid removal may omelliorate myocardial perfusion and thus anti arrhythmic Wizemann V ., Kramer W. Cardiac arrhythmia in end stage renal disease : prevalence

- Atrial and ventricular arrhythmias are common during hemodlyysis.


**DIALYSIS DISEQUILIBRUM SYNDROME**

Dialysis disequilibrium syndrome is an acute disorder of central nervous system in patients with end stage renal disease treated with haemodialysis. Individuals with pre-existing neurological disorders such as stroke, head trauma, sub-dural hematoma or malignant hypertension are at increased risk. Restlessness, headache, nausea vomiting disorientation and tremer, seizures and coma. Symptoms usually occur towards the end of dialysis session but may be delayed for upto 24 hrs.
Cause: Brain osmolarity exceeds that of plasma leading to cerebral edema -

- Individual with preexisting neurological disorders such as stroke, head trauma, sub-dural hematoma or malignant hypertension are at increased risk of DDS.

Peteron HD, Acute encephalopathy occurring during hemodialysis. Arch Intern Med 1964; 113; 877-880

- Port FK Johason WJ, Klass DW. Prevention of dialysis DS by use of high sodium concentration in dialysate kidney Int 1973; 327-333. Demonstration that DDS occur in maintenance hemodialysis patients.

- Full blown disequilibrium syndrome has become rare in recent years. Improvements in dialysis delivery technology including bicarbonate dialysate, high dialysate sodium concentration
and controlled hyperfiltration are responsible for decreasing frequency and severity of DDS.

Graefe V, Milutinovids ui, Follete WC et al., less dialysis induced morbidity and vascular instability with bicarbonate dialysate. Kidney int. 1978-88: 332-336

- Arief Al. Dialysis disequilibrium syndrome: Current concept on pathogenesis and prevention. Kidney Int. 1994; 45:629-635 demonstrated rapid hemodialysis may induce disequilibrium stage characterized by increased CSF pressure fall in CSF pH and bicarbonate concentration.

**NAUSEA AND VOMITING**

Most episodes in stable patient are probably related to hypotension it is also part of disequilibrium syndrome.

**HEADACHE**

Headache is common symptom during dialysis -

1. May be part of disequilibrium syndrome.
2. May be related to use of acetate containing dialysis solution

3. In Coffee drinker may be due to caffeine withdrawal.

**CHEST PAIN AND BACK PAIN**

The most common cause of chest pain is "First-use syndrome".

**FEVER**

Causes are

1. Temporary vascular access infection.

2. Permanent vascular access infection.

**Microbe responsible**

- Staphylococci and streptococci
- Some time diphtheriods and gram negative bacilli.

- Report indicate higher risk of pyrogenic reaction in units that reprocess high flux dialyzers compared with units that reprocess cellulosic membrane.

- Fibrile reaction usually begins short after the initiation of dialysis and may resolve spontaneously over the course of treatment.


**OTHER COMPLICATIONS**

*Hyperglycemia -*

Hyperglycemia is common during dialysis and may be due to positive glucose balance that occurs when glucose containing dialysate is used.

Gatiesserz A, Bergstrom J, Alvestrand A: Hemodialysis associated protein catabolism with and

The use of high glucose dialysate (>200mg%) can lead to net gain of 10-100 gm of glucose. The resulting hyperosmolarity in the absence of insulin can precipitate hyperkalemia in post dialytic period. Esforzado N., Poch E, Casis C, et al central pontine myelinolysis secondary to treatment and rapid stuff in plasma glucose in diabtic hemodialytic patient. Transplantation 1992: 744-746.

**Hypoglycemia**

Hypoglycemia is multifactorial

Alcohol abuse, liver disease and prolonged digradation of Insulin or oral hypoglycemic agents may contribute to inter and intradialytic hypoglycemia use

Use of glucose free dialysate can produce a net fluucose loss of 3 gm during hemodialysis. Gracjower MM walter L. Arhins. Hypoglycemia in chronic dialysis

**Hyperkalemia** -

Though difficult to predict for any given treatment, net removal of potassium per treatment is only in the range of 100 mEq, even with potassium free dialysate,

Plasma potassium level may rebound by up to 30% within 5 hours after completion of dialysis.

In a patient being treated for severe hyperkalemia the immediate post dialysis potassium levels should not be used to gauge effectiveness of treatment. Level should be measured 2 or 3 hours later.

**Hypokalemia** -

Life threatening muscular weakness and arrhythmias have been reported to occur as a result of intradialytic hypokalemia. Patient with marginal total body potassium store and severe acidosis are prone to these complications.
Alkalosis -

Clinical feature: Hypoventilation, Neuromuscular and CNs symptoms including confusion, obtundation, stupar, tetany, seizures.

Acidosis -

The diagnosis is suggested by acute onset of hyperventilation during dialysis.

Cause - Alcohol abuse
- Diabetic ketoacidosis
- in proper mixing of concentrate.