

BC PROVINCIAL GUIDELINES

INTRADIALYTIC PARENTERAL NUTRITION (IDPN)

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**PROPOSED BC PROVINCIAL GUIDELINES FOR
INTRADIALYTIC PARENTERAL NUTRITION (IDPN)**

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These IDPN guidelines are based on the best information available at the time of publication as well as current clinical practice.

Healthcare professionals using these guidelines are responsible for evaluating the appropriateness of applying them to specific clinical situations.

Currently, the approximate per treatment cost of IDPN is \$26.00 (\$20.00 for solutions and \$6.00 for tubing).

DESCRIPTION

Intradialytic parenteral nutrition (IDPN) is the provision of nutrients through the venous drip chamber while the patient is undergoing hemodialysis. The solution is administered with an infusion pump at a constant rate.

RATIONALE FOR USE

“When compared to the demographically adjusted general population, dialysis patients experience greater signs and symptoms of wasting, malnutrition, morbidity and mortality. It is estimated that 50% to 70% of dialysis patients suffer from PEM (Protein Energy Malnutrition). In adults, the presence of PEM is one of the strongest predictors of morbidity and mortality.”¹

There are several factors that are responsible for malnutrition in hemodialysis patients, including but not limited to the following: ^{1,2}

- dietary restrictions
- taste alterations/lack of appetite
- loss of nutrients during dialysis
- chronic inflammation
- metabolic and hormonal disturbances
- superimposed illnesses and infections
- gastroparesis.

For some malnourished patients where standard nutrition intervention has been unsuccessful, IDPN is a feasible option. IDPN is insufficient to meet the nutrient needs of patients. However, it does provide substantial calories and protein to augment oral intake. Randomized controlled trials are needed to define the impact of IDPN on nutritional status and support its efficacy in improving clinical outcomes.

CONTRAINDICATIONS

- Allergy to eggs, corn or sulfites
- Excessive, chronic fluid overload
- Patient refusal to initiate IDPN
- Patient is palliative with no anticipated increase in quality of life with IDPN

CRITERIA FOR INITIATION (adapted from 3,4)

A renal dietitian should assess the appropriate use of IDPN

Patients must meet any **three** of the following criteria:

- 3 month average serum albumin <34 g/L
- Unintentional weight loss of >10% of usual body weight. (UBW) or current weight <90% of ideal body weight. (IBW)
- Subject Global Assessment (SGA): score B or C indicating moderate to severe malnutrition
- Diet history showing a decreased intake:
 - Protein <1.0g/kg/day
 - Calories <25 kcal/kg/day (≤30 kcal/kg/day for those with higher calorie requirements)
- Documented diagnosis of a gastrointestinal disorder (e.g. gastroparesis, malabsorption syndromes)

AND the patient must demonstrate the following:

- Failed attempts to increase nutritional status with oral nutritional supplements
- Is not a candidate for tube-feeding (e.g. where nasogastric or gastrostomy feeding is unsafe or impractical)
- Is able to meet greater than or equal to 50% of needs orally

CRITERIA FOR DISCONTINUATION (adapted from 4)

Patient must meet any **three** of the following criteria:

- 3 month average serum albumin >34 g/L
- Increasing dry weight trend
- Improved SGA score: A or B
- Increased oral intake to:
 - Protein > 1.0g/kg/day
 - Calories > 25 to 30 kcal/kg/day

OR the patient demonstrates **one** of the following:

- No benefit after 6 months of IDPN
- Complications of/intolerance to IDPN

COMPOSITION AND ADMINISTRATION

IDPN solutions are the same as other central TPN solutions. Protein is supplied as amino acids, carbohydrate as dextrose and lipids as a soybean emulsion. All three macronutrients can be combined together to form a three-in-one admixture. Alternatively, amino acids and dextrose can be combined in one bag and lipids alone in another.

- There are no definitive guidelines on how to initiate IDPN. Individual needs and the tolerance of each patient should be taken into account. It may be prudent to start patients at half the goal volume and progress to goal depending upon glycemic control and tolerance to the infusion. Starting slowly and working up to a level that provides maximum nutrients will assist with preventing adverse side effects.⁵

Protein:

Currently, the most commonly used solution in B.C. contains 10% amino acids. An optimal IDPN treatment provides at least 50 grams of protein. Lower protein intakes result when fluid volume must be limited.

250 ml of a 10% amino acid solution = 25 grams of protein

500 ml of a 10% amino acid solution = 50 grams of protein

- Calories from all energy sources, including amino acids, are used to calculate the total energy being provided⁸.
- Each gram of protein provides 4 kcal.

Carbohydrate:

- Currently, concentrated sources of dextrose (e.g. Dextrose 70% or Dextrose 50%) are used to achieve the final dextrose concentration ordered.

250 ml of a 50% dextrose solution = 125 grams of dextrose

- Each gram of dextrose provides 3.4 kcal.
- Unlike TPN where the maximum glucose infusion is 5 mg/kg/min, IDPN often exceeds this rate as it is generally infused over 3.5-4.0 hours.

Fat:

- Fat is a concentrated source of calories and provides essential fatty acids.
- At the time of this publication, the most commonly used solution in BC is a 20% lipid emulsion, which provides 2 kcal/mL.

250 ml of 20% lipid = 50 grams of Fat

- Each gram of fat provides 10 kcal (due to emulsifying agent).
- Fat should not exceed 60% of total calories.
- Lipid emulsions contain Vitamin K and egg phospholipid⁶.
- Maximum clearance rate of 20% lipid is 1 ml/minute or 60 ml/hour.
- In practice, up to 250 ml of 20% lipid is infused over 3.5 to 4.0 hours. For run times shorter than 3.5 hours, a smaller volume is infused.

Additional Ingredients:

- **Vitamins, minerals and electrolytes** – These are not routinely added but may be required for selected patients with high exogenous losses (e.g. high output fistulas/ostomies; Crohn's Disease)
- **Insulin** – Glycemic control is a major concern with IDPN given the relatively high rate of dextrose infusion. Blood glucose should be monitored before, during and at the end of the hemodialysis run. Insulin should be considered when serum glucose levels exceed 16.5 mmol/L^{6,8}. In this situation, five units of regular insulin per 1000mL of IDPN solution has been suggested as an initial starting dose, with incremental increases of 2 units^{6,8} as needed. Serum glucose levels should not fall below 6.0 mmol/L. A snack of 15-30 grams of carbohydrate near the end of the hemodialysis run (20-30 minutes) is recommended to prevent post dialysis hypoglycemia.

POTENTIAL METABOLIC COMPLICATIONS^{adapted from⁷}

Observation	Possible Cause	Management
Hyperglycemia	<ul style="list-style-type: none"> • Pre-existing diabetes • Infection • Rapid infusion of dextrose • Concurrent steroid therapy 	<ul style="list-style-type: none"> • Regular insulin added to IDPN • Sliding scale insulin subcutaneously • Observe for signs and symptoms of infection • Routine blood glucose monitoring • Do <u>not</u> speed up infusion to compensate for lost time
Hypoglycemia	<ul style="list-style-type: none"> • Hyperinsulinemia can persist if concentrated dextrose solution is discontinued abruptly 	<ul style="list-style-type: none"> • Monitor blood glucose post IDPN • Provide and encourage a snack of 15-30g of carbohydrate 20-30 minutes prior to discontinuing IDPN • Adjustment of insulin prn
Electrolyte Abnormalities Associated with Refeeding	<ul style="list-style-type: none"> • Infusion of dextrose can cause an intracellular shift of electrolytes • Increased demand for electrolytes due to anabolism 	<ul style="list-style-type: none"> • Routine monitoring of potassium, magnesium and phosphorus
Respiratory Distress	<ul style="list-style-type: none"> • Excessive CHO load resulting in increased CO₂ production. • Too rapid infusion of IDPN • Most likely to occur when glucose is the sole non-protein energy source (e.g. no lipid) 	<ul style="list-style-type: none"> • Observation and evaluation of pulmonary status • Provide dextrose and lipid in a 50:50 energy ratio • Ensure patient's "dry" weight is obtained by the end of the dialysis session
Abnormal Liver Function (Elevated Liver Enzymes, Hypertriglyceridemia, Hepatic Steatosis)	<ul style="list-style-type: none"> • Hyperglycemia • Excessive lipid and/or carbohydrate intake 	<ul style="list-style-type: none"> • Mandatory testing of ALT, Alk Phos, total bilirubin, TG • Controlling BG • Prescribing appropriate amounts and infusion rates of macronutrients

MONITORING SUGGESTIONS

	Parameter	Schedule
Laboratory Tests (Predialysis)	CBC Electrolytes (K ⁺ , Ca ⁺⁺ , P04 ⁻ , Mg ⁺⁺) Urea	Initial treatment, weekly x 2 weeks, then every 4-6 weeks to coincide with regular dialysis blood work.
	Albumin, Liver Function Tests (alk phos, AST, Total bilirubin) Triglycerides Creatinine	Initial treatment, then every 4-6 weeks to coincide with routine dialysis blood work schedule.
Monitoring During Runs	Weight, BP, heart rate, temperature Blood glucose via glucose meter* *CONTACT MD: if glucose < 6.0 or > 16.5 mmol/L	Pre and post each IDPN Non-diabetic: pre, mid and 30 min post for first 3 IDPN runs Diabetic: pre, mid and 30 min post for 6 IDPN runs, then weekly ** Note: Continue glucose monitoring if BG is >16.5 mmol/L AND resume glucose monitoring when making any adjustments in dextrose volume.

SPECIAL CONSIDERATIONS:

- Interruptions:
 - For dialysis interruption longer than 10 minutes, hold IDPN. Once dialysis is re-initiated, recommence infusing solution at the previous rate. Do not increase the rate of infusion to compensate for lost time. Discard the remainder of the solution upon discontinuation of dialysis.
- Medication Guidelines:
 - **Antibiotics:** Vancomycin (usually given over the last hour of dialysis) or other antibiotics (given during dialysis) should not be infused through the same chamber as IDPN. The IDPN solution should be switched to the arterial chamber and the antibiotic infusion should be given via the venous chambers. For those who are on single needle dialysis, IDPN should be discontinued when antibiotics are being infused.
 - **Iron Products:** Iron products should be infused through the arterial chamber with the IDPN solution continuing in the venous chamber. For single needle dialysis patients, IDPN should be discontinued prior to administration of IV iron.
 - **For Iron Dextran test dose:**
 - If a patient is already receiving IDPN for at least 3 runs, test dose of iron may be given.
 - If a patient has been receiving IDPN for less than 3 runs, hold IDPN for that run and administer IV iron test dose.
 - If a patient is receiving IDPN for the first time and is already receiving iron, iron does not need to be held.
 - **Blood Products:** Blood/blood products may be given concurrently with IDPN infusion during dialysis. Ensure that the blood/blood products and IDPN are not infused via the same chamber. For single needle dialysis patients, IDPN should be held for that dialysis session.

Date: _____ Time: _____ Dialysis Days/Run Time

Time Processed
RN/LPN Initials
Comments

A. Initiate IDPN for _____ weeks.

B. IDPN Formula and Infusion Rate

IDPN Formula (check box)	<input type="checkbox"/> Total Volume 750mL¹	<input type="checkbox"/> Total Volume 1000mL¹
	Amino Acid 10% w/o Lytes 250 mL Dextrose 50% 250 mL Fat Emulsion 20% 250 mL	Amino Acid 10% w/o Lytes 500 mL Dextrose 50% 250 mL Fat Emulsion 20% 250 mL
Dialysis Run Time (check box)	Infusion Rate²	Infusion Rate²
<input type="checkbox"/> 3.5 h	225 mL/hour	300 mL/hour
<input type="checkbox"/> 4.0 h	195 mL/hour	260 mL/hour

¹ Total non-protein calories = 925 kcal

² Ten minutes total start-up/take-off time has been considered in rate calculations

C. IDPN Schedule

	Parameter	Schedule
Laboratory Tests (Predialysis)	CBC Electrolytes (K ⁺ , Ca ⁺⁺ , PO4 ⁻ , Mg ⁺⁺) Urea	Initial treatment, weekly x 2 weeks, then every 6 weeks
	Albumin Liver function tests (alkaline phosphatase, AST, total bilirubin) Triglycerides Creatinine	Initial treatment, then every 6 weeks
	Zinc	Initial treatment only
	Monitoring During Runs	Weight, BP, heart rate, temperature Blood glucose via glucose meter* *CONTACT MD if glucose < 6 or > 18 mmol/L

Physician Signature
IDPN

Printed Name/PIC
Rev. Dec-06

SAMPLE FROM VANCOUVER COASTAL HEALTH



fraserhealth
 PRE-PRINTED ORDERS FOR
 INTRADIALYTIC PARENTERAL NUTRITION

Patient Data

Bar Code Area

Bar Code Area

ADDI000001A

Rev: Aug 01/08

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DRUG & FOOD ALLERGIES

Must Do **Optional, Physician please (✓) as appropriate** (Physician please cross out and initial any orders not indicated)

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Date: _____

Time: _____

▪ **Central TPN:**

Dextrose 20 %, Travasol 6% 500 mL
 Protein: 60 g / 1000 mL 750 mL
 920 kcal / 1000 mL

▪ **ADDITIVES (per IDPN bag):**

Regular Human Insulin _____ units
 Others: _____

▪ **LIPID EMULSION: 20%**

(provides 0.2 Gm Fat/mL & 2 Kcal/mL)
 250 mL Frequency: _____
 * maximum rate of 85 mL/hour

▪ **ADMINISTRATION:**

1. Start Time and Date: _____

2. Infuse IDPN over _____ hours during dialysis
 _____ times per week.

3. Planned dialysis schedule:

Day	Time

▪ **NUTRITIONAL SUPPORT**

▪ Provide patient with liquid renal nutritional supplement (e.g. Nepro®) at treatment end.

IDPN ORDERING PROCEDURE

1. A renal dietician consult is recommended prior to ordering intra-dialytic parenteral nutrition (IDPN).
2. An IDPN order form must be completed for each new or changed TPN order.
3. A copy must be faxed to pharmacy by 1400. Orders received after 1200 hours (noon) will be processed the following day. The original copy will remain on the chart.
4. To order additives check appropriate box and identify other additives and dose(s) required in space provided.

Routine Bloodwork

1. Baseline to be done predialysis, at first IDPN – CBC, potassium, calcium, phosphorous, magnesium, glucose, bili (total and direct), alk phosphatase, AST, calcium, magnesium, phosphate, albumin, triglycerides. Repeat baseline bloodwork three weeks after commencing IDPN.
2. At third IDPN infusion – pre-IDPN potassium, phosphorous, magnesium.
3. First four IDPN infusions – glucometer pre-IDPN, one hour after commencing and post-IDPN.
4. Repeat Bili (total and direct), Alk phosphatase, AST and triglycerides q 6 weeks with routine renal bloodwork.

SI Unit Conversions	SI Units	mEq
Ca ⁺⁺	1 mM	2 mEq
Mg ⁺⁺	1 mM	2 mEq
Na ⁺	1 mM	1 mEq
K ⁺	1 mM	1 mEq
Cl ⁻	1 mM	1 mEq

Physician Signature: _____ (Printed: _____)

REFERENCES

- ¹ National Kidney Foundation. K/DOQI Clinical practice guidelines for nutrition in chronic renal failure. *Am J Kidney Dis.* 2000;35 (suppl): S1-S104.
- ² Cato, Y. Intradialytic parenteral nutrition therapy for the malnourished hemodialysis patient. *Journal of Intravenous Nursing.* 1997;20(3): 130-135.
- ³ Cherry, N and Shalansky, K. Efficacy of Intradialytic parenteral nutrition in malnourished hemodialysis patients. *Am J Health-Syst Pharm.* 2002;59: 1736-1741.
- ⁴ Lazarus, JM. Recommended Criteria for Initiating and Discontinuing Intradialytic Parenteral Nutrition Therapy. *American Journal of Kidney Diseases.* 1999;33(1): 211-216.
- ⁵ McCann, L. Pocket Guide to the Nutritional Assessment of the Patient with Kidney Disease, Council of Renal Nutrition of the National Kidney Foundation, 3rd Edition, 2002.
- ⁶ American Dietetic Association and Dietitians of Canada. Intradialytic Parenteral Nutrition. In: *Manual of Clinical Dietetics – 6th ed.* Chicago, Ill: American Dietetic Association: 2000: 642-646.
- ⁷ Nelson, Linda et al. *Intradialytic Parenteral Nutrition Self Learning Package.* Royal Columbian Hospital Department of Education; 1996.
- ⁸ Fuhrman, M.P. Parenteral Nutrition in Kidney Disease. In: *Clinical Guide to Nutrition Care in Kidney Disease.* Chicago, Ill: American Dietetic Association; 2004: 159-174.

SUMMARY OF IDPN REFERENCES **(Reviewed by J. Aviani 2007)**

1. Meeting abstract to be presented at the NKF 2007 Spring Clinical Meeting in Apr 2007.

Intradialytic parenteral nutrition IDPN: Changes in albumin, total protein, dry weight, BUN, and creatinine after 3 to 12 months of therapy. Deborah Scholl, Richard Dowling, Michelle Ricker, Stan Lindenfeld, Pentec Health Inc. Boothwyn, PA, USA

Observational retrospective study of response to IDPN in 164 HD patients. Conclusion: IDPN was well tolerated and resulted in positive responses in albumin, total protein, and BUN. IDPN appears to be an effective therapy for raising albumin levels in MHD patients with protein malnutrition.

2. Cano N: Nutritional supplementation in adult patients on hemodialysis. J Ren Nutr 17:103-105, 2007

In the French Intradialytic Nutrition Evaluation study (FineS) investigators evaluated the effects of 1 year IDPN given in addition to oral supplements. The addition of IDPN to oral supplements did not improve mortality, hospitalization, disability, or nutritional status.

An efficient nutrition support, independent from the way of supply, improved nutritional status and significantly increased survival.

Main limitation of oral supplementation may be patient compliance.

3. Avery-Lynch M: Intradialytic parenteral nutrition in hemodialysis patients: Acute and chronic intervention. The CANNT Journal 16:30-33, 2006

This study in Peterborough had 8 HD patients receive IDPN from 1.5 to 16 months. They saw mean increase in albumin of 7 g/L, nPNA increased significantly by .65 and average weight increased by 1.13 kg

Concluded: IDPN is costly and will continue to be reserved for malnourished patients who fail enteral nutrition supplements.

4. How PP, Lau AH: Malnutrition in patients undergoing hemodialysis: Is intradialytic parenteral nutrition the answer? Pharmacotherapy 24:1748-1758, 2004

Many patients have PEM. Most patients with ESRD have protein and energy intake levels below KDOQI guidelines. Growing body of data shows malnutrition correlates with increased morbidity and mortality.

Management of malnutrition includes nutritional counselling and oral supplements. The problem is that many patients have decreased appetite and do not tolerate increased intake and/or oral supplements. Enteral feeds have the disadvantages of possible GI intolerance and risk of aspiration and infection. IDPN has the advantage of convenience, vascular access already available. Disadvantages of IDPN include cost, need for several months treatment before improvement seen, and it does not meet 100% of requirements.

Based on studies currently available response to IDPN was dependent on baseline nutritional status and duration of treatment. Patients who were malnourished benefited more.

Capelli et al in Am J of Kidney Diseases 1994;23:808-816. IDPN given to 81 malnourished patients for 9 months. Results showed significant weight gain and decreased mortality with IDPN.

Retrospective studies showed patients who received IDPN demonstrated reduced hospitalization rates, length of stay and costs.

The authors conclude: Based on the available studies it appears IDPN use in malnourished HD patients may result in decreased morbidity and mortality. Large scale randomized controlled trials are needed to confirm this.

5. Pupim LB, Flakoll PJ, Ikizler TA: Nutritional supplementation acutely increases albumin fractional synthetic rate in chronic hemodialysis patients. J Am Soc Nephrol 15:1920-1926, 2004

Fractional synthetic rate (FSR) of albumin provides a direct estimate of acute changes in hepatic albumin synthesis. Authors studied 7 HD patients during 2 HD sessions, one with IDPN and one without. Study design was randomized cross-over with 4 week period between sessions. Results indicate that IDPN significantly improves FSR of albumin (84% increase in IDPN session vs 54% increase in control session). IDPN also increased whole body protein synthesis by 83% vs 17% increase in control session. Issue with the study is that the population was well-nourished without evidence of inflammation, so it is unknown if the results would also occur in malnourished patients. The study demonstrated short term effects only.

Authors conclude that IDPN is protein anabolic in the acute setting in chronic HD patients.

6. Cano N: Intradialytic parenteral nutrition: Where do we go from here? J Ren Nutr 14:3-5, 2004

Author reviews the 30 studies that addressed the nutritional effects of IDPN. Most reports come from cohort studies. There were 5 non-randomized trials that compared patients treated with IDPN with control patients. All these showed an improvement of the measured nutritional outcomes.

One randomized controlled trial compared 12 patients on IDPN for 3 m vs 14 controls and showed an improvement in body weight, AMC, TSF, albumin and prealbumin.

The data seems to argue for the metabolic and nutritional efficacy of IDPN, however a key point for clarifying the indications of IDPN is to evaluate the effect on morbidity and mortality and better characterize the patients who could best benefit from this treatment.

The author discusses Foulks CJ: The effect of intradialytic parenteral nutrition on hospitalization rate and mortality in malnourished hemodialysis patients. J Renal Nutr 4:5-10, 1994.

Study reports when the nutritional status was improved, the 9-month survival was increased and the hospitalization rate was reduced.

7. Czekalski S, Hozejowski R: Intradialytic amino acids supplementation in hemodialysis patients with malnutrition: Results of a multicenter cohort study. J Ren Nutr 14:82-88, 2004

The study provided 500 cc 10% amino acid solution and followed serum albumin, SGA, weight, MAC, TLC. 107 patients completed 6 months. Mean albumin concentration increased significantly from 32.5 to 37.1. The rate of improvement correlated significantly and negatively with baseline albumin concentration. The change in albumin correlated significantly with the number of amino acid administrations at 3 months. The SGA score improved significantly as well from 16 to 11. SGA score correlated significantly with albumin. Higher frequency of amino acid supplementation also correlated with better improvement in SGA score. Weight remained the same but MAC changed significantly.

Authors conclude that the results suggest favourable effect of amino acid supplementation is particularly evident in patients with more pronounced signs of malnutrition. The results show the amino acid supplementation for 6 m in malnourished HD patients significantly improves selected nutritional parameters. Both increased albumin and improved SGA score correlated with quantity of amino acid infusions which confirms that the beneficial effect of amino acid supplementation depends on the intensity of treatment.

8. Serna-Thome MG, Padilla-Rosciano AE, Suchil-Bernal L: Practical aspects of intradialytic nutritional support. *Curr Opin Clin Nutr Metab Care* 5:293-296, 2002

Authors conclude that it is clear that malnutrition in HD patients is common and generally associated with increased morbidity and mortality.

Retrospective data analyses have demonstrated that IDPN is a satisfactory method to modify the outcome in patients. IDPN may represent a useful therapy in those malnourished patients with nutritional requirements that cannot be fully met by oral intake and in whom enteral nutrition has been contraindicated.

9. Cherry N, Shalansky K: Efficacy of intradialytic parenteral nutrition in malnourished hemodialysis patients. *Am J Health-Syst Pharm* 59:1736-1741, 2002

In this study patient data was collected up to 6 m before IDPN began allowing patients to act as their own controls.

Criteria to start IDPN were any 3 of the following:

- 1) Albumin < 34
- 2) Unintentional weight loss > 10% body weight or current weight < 90% IBW
- 3) Diet history shows a decrease in the intake of protein to <1 g/kg/d or of calories to < 25 kcal/kg/d
- 4) SGA yields a B or C rating, indicating moderate to severe malnutrition
- 5) Protein catabolic rate is < 1 g/kg/d
- 6) There is a documented diagnosis of a gastrointestinal disorder (eg gastroparesis, malabsorption syndrome).

AND: Patient can meet greater than or equal to 50% of needs orally and has not been able to increase oral intake with supplements, is not a candidate for tube feed and all attempts have been made to achieve adequate dialysis.

The authors assessed the efficacy of IDPN by %change from baseline in serum albumin concentration and dry body weight. Patients were assessed at 3 and 6 months before IDPN therapy began and at 3, 6, 9 and 12 months after.

The authors conclude the use of IDPN for mean of 4.3 months in malnourished HD patients reversed a significant downward trend in dry body weight before initiation and significantly increased dry body weight at 6, 9, 12 months after therapy began. Study demonstrated a significant increase in body weight and serum albumin in malnourished HD patients who received IDPN for 3-6 months.

10. Pupim LB, Flakoll PJ, Brouillette JR et al: Intradialytic parenteral nutrition improves protein and energy homeostasis in chronic hemodialysis patients. *J Clin Invest* 110:483-492, 2002

Net whole body protein accretion improved substantially during IDPN administration in contrast with net catabolism during regular HD. Findings clearly support the premise that the infused amino acids are retained and used by these patients. The study only reports on short term effects of IDPN on non-malnourished patients. The authors summarize that IDPN has a positive effect on protein and energy metabolism in stable chronic HD patients.

11. KDOQI Guidelines *Am J Kid Dis* 35:S49, 2000

Maintenance HD patients who satisfy each of the following 3 criteria may benefit from IDPN:

- 1) Evidence of protein or energy malnutrition and inadequate dietary protein and/or energy
- 2) Inability to administer or tolerate adequate oral nutrition including supplements or tube feed
- 3) The combination with oral or enteral intake which, when combined with IDPN will meet the individual's nutritional needs

Previously published studies support the use of IDPN for selected maintenance HD patients who are malnourished and eating poorly.

12. Mortelmans AK, Vanholder R: Intradialytic parenteral nutrition in malnourished hemodialysis patients: Review of the literature. *Miner Electrolyte Metab* 25:324-332, 1999

IV route may be the only solution when nutritional advice and oral supplements give insufficient results. Proven benefit is still controversial however several authors find it reasonable to try IDPN in severely malnourished HD patients when other measures fail.

The authors conclude that prospective, controlled long-term studies in malnourished HD patients using IDPN are scarce. High mortality rate of malnourished HD patients makes it difficult to include untreated control groups because of ethical constraints. Studies that demonstrated a beneficial result of IDPN required about 3 months of therapy before significant improvement could be noted.

Several studies point to an improvement of patient condition when parenteral nutrition is administered during HD in malnourished patients showing no benefit from oral supplementation. Unequivocal proof of benefit by prospective trials is lacking at this moment.

13. Pupim LB, Kent P, Hakim R: The potential of intradialytic parenteral nutrition: A review. *Miner Electrolyte Metab* 25:317-323, 1999

Generally renal professionals manage PCM using a conventional approach (which does not include IDPN) however for a small % of malnourished patients IDPN is the treatment of choice. This group often does not tolerate oral supplementation and/or may refuse enteral tube feed.

Arguments against IDPN include the hypothesis that treatment of malnutrition requires treatment of the ongoing catabolic process, that it's expensive and lack of studies documenting effectiveness.

A problem with the use of oral supplements is that malnourished patients often have decreased appetite and do not tolerate increased oral intake making oral supplementation difficult. PEG feeding may not be tolerated and has risk of aspiration and infection.

Medicare criteria of a documented small bowel disease or GI motility disorder and demonstrated malnutrition result in restrictive qualifications which make it difficult to design a study to demonstrate effectiveness.

Authors refer to Cranford W: Cost-effectiveness of IDPN therapy measured by hospitalizations and length of stay. Nephrology News & Issues 1998;12:33-39. Demonstrated cost-effectiveness but was retrospective and not controlled.

Authors conclude: data currently available indicates the impact of IDPN on nutritional status and clinical outcome is not precisely defined and there is a need for a randomized long term prospective trial looking at frequency and length of hospitalization to capture costs and mortality.

14. Lazarus JM: Recommended criteria for initiating and discontinuing intradialytic parenteral nutrition therapy. Am J Kid Dis 33:211-216, 1999

Table 1 Criteria for Initiating

- 1) 3 m rolling average albumin <3.4g
- 2) 3 m rolling average creatinine < 8.0 mg
- 3) weight loss > 10% IBW or 20% UBW
- 4) clinical exam consistent with moderate to severe malnutrition
- 5) history of decreased intake protein < .8 g/kg or calories < 25 kcal/kg
- 6) SGA score C

any 3 of above with: failed attempts at increased dietary and oral supplemental therapy, refusal to undergo enteral tube feeding

except for patients who truly have permanent and totally diseased GI tract IDPN should be short term of 4-6 months

Table 2 Criteria for Discontinuing IDPN:

- 1) Attaining a 3-month rolling average predialysis serum albumin of 3.8 g or greater
- 2) Attaining a 3-month rolling average serum creatinine of 10 mg/dL or greater
- 3) Clinical examination of improving nutrition, including increased dry weight
- 4) SGA A or B rating
- 5) Increase in oral intake to: Protein intake >1.0 g/kg Calorie intake > 30 kcal/kg

Any 3 of above or either no improvement after 6 m of IDPN or complications/intolerance of IDPN

15. Wolfson M, Foulks CJ: Intradialytic parenteral nutrition: A useful therapy? Nutrition in Clinical Practice 11:5-11, 1996

Thorough review of published articles suggests a relationship between the use of IDPN and improved patient outcome measured by hospitalization rate and decreased mortality in certain subgroups.

Best recommendation that can be made for IDPN is that it may represent a useful form of nutrition support in the malnourished HD patient who has no other active disease processes, cannot ingest adequate nutrition orally and is not a candidate for enteral feeding.

Multiple reports note IDPN is associated with increased appetite and well-being. It is not known if this is secondary to the increased attention of the physician and dietitian in addressing problems like underdialysis, anorexia, medication effects, depression and other issues that can contribute to malnutrition.

Why are tube feeds not often used in HD patients?

- concern on volume overload
- cost
- invasiveness
- presumed patient discomfort
- patient refusal

Advantage of IDPN is presence of vascular access simplifies the nutrition intervention, does not result in compliance issues.

IDPN may be a useful therapy in certain patient groups however attention to other problems that may cause anorexia or malnutrition must be sought and remedied.

16. Chertow GM, Ling J, Lew NL et al: The association of intradialytic parenteral nutrition administration with survival in hemodialysis patients. *Am J Kid Dis* 24:912-920, 1994

Data showed marginally significant reduction in odds of death with IDPN treatment when patients with albumin < 34 were analyzed and a highly significant reduction in patients with albumin < 33

Possible reasons include: IDPN reduces malnutrition or possible placebo effect (due to increased physician attention, nutritional counselling)

The authors summarize: data demonstrate an association between IDPN treatment and enhanced survival in malnourished HD patients