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Abstract

OBJECTIVE: Glutamine (Gln)-supplemented total parenteral nutrition (TPN) improves clinical outcome after planned surgery, but the benefits of Gln-TPN for critically ill (intensive care unit; ICU) patients are still debated. DESIGN: Prospective, double-blind, controlled, randomized trial. SETTING: ICUs in 16 hospitals in France. PATIENTS: One-hundred fourteen ICU patients admitted for multiple trauma (38), complicated surgery (65), or pancreatitis (11). INTERVENTIONS: Patients were randomized to receive isocaloric isonitrogenous TPN via a central venous catheter providing 37.5 kcal and 1.5 g amino acids.kg-1.day-1 supplemented with either L-alanyl-L-glutamine dipeptide (0.5 g.kg-1.day-1; Ala-Gln group, n=58) or L-alanine+L-proline (control group, n=56) over at least 5 days. MEASUREMENTS AND MAIN RESULTS: Complicated clinical outcome was defined a priori by the occurrence of infectious complications (according to the criteria of the Centers for Disease Control and Prevention), wound complication, or death. The two groups were compared by chi-square test on an intention-to-treat basis. The two groups did not differ at inclusion for type and severity of injury (mean simplified acute physiology score II, 30 vs. 30.5; mean injury severity score, 44.9 vs. 42.3). Similar volumes of TPN were administered in both groups. Ala-Gln-supplemented TPN was associated with a lower incidence of complicated outcome (41% vs. 61%; p<.05), which was mainly due to a reduced infection rate per patient (mean, 0.45 vs. 0.71; p<.05) and incidence of pneumonia (10 vs. 19; p<.05). Early death rate during treatment and 6-month survival were not different. Hyperglycemia was less frequent (20 vs. 30 patients; p<.05) and there were fewer insulin-requiring patients (14 vs. 22; p<.05) in the Ala-Gln group. CONCLUSIONS: TPN supplemented with Ala-Gln dipeptide in ICU patients is associated with a reduced rate of infectious complications and better metabolic tolerance.
Intradialytic parenteral nutrition: comparison of olive oil versus soybean oil-based lipid emulsions


Abstract

Lipid, oxidative and inflammatory parameters are frequently altered in dialysis patients and may be worsened by intravenous lipid emulsions (ILE). We assessed the efficacy and tolerance of olive as compared with standard soybean oil-based ILE during intradialytic parenteral nutrition (IDPN). IDPN mixtures containing amino acids, glucose, and either olive oil (OO group, n 17) or soybean oil-based ILE (SO group, n 18) were administered in a 5-week randomized, double-blind study. On days 0 and 35, patients' nutritional status was assessed by BMI, normalized protein catabolic rate, predialytic creatinine, serum albumin and transthyretin; lipid metabolism by plasma LDL- and HDL-cholesterol, triacylglycerols, phospholipids, apo A-I, A-II, B, C-II, C-III, E and lipoprotein (a); oxidative status by alpha-tocopherol, retinol, selenium, glutathione peroxidase, malondialdehyde and advanced oxidized protein products; inflammatory status by serum C-reactive protein, orosomucoid, IL-2 and IL-6. No serious adverse event was observed. Significant changes were observed from day 0 to day 35 (P<0.05): nutritional criteria improved (albumin in OO; albumin, transthyretin and creatinine in SO); LDL-cholesterol, apo B, C-II, C-III and apo A-I/A-II ratio increased in both groups. HDL-cholesterol decreased in OO; apo E increased and lipoprotein (a) decreased in SO; alpha-tocopherol/cholesterol ratio increased in OO; malondialdehyde decreased in both groups; IL-2 increased in both groups. The between-group comparison only showed the following differences: alpha-tocopherol/cholesterol increased in OO; lipoprotein (a) decreased in SO. From these data, it was concluded that OO- and SO-based IDPNs similarly improved nutritional status and influenced plasma lipid, oxidative, inflammatory and immune parameters.

Parenteral nutrition

Forbes A.


Abstract

PURPOSE OF REVIEW: During the past 12 months there have been clinically important advances in intravenous nutrition and adjunctive therapies. RECENT FINDINGS: Useful steps have been taken in the understanding of the altered physiology of the intravenously fed patient, the potential for specific gains from manipulation with gut hormones, and avoidance of complications from amended lipid emulsions. The role of the nutrition team and the place of IVN in malignancy have also been addressed. SUMMARY: Glucagon-like peptide-2, and lipid emulsions based less on soy-bean oil appear safe and effective. Euglycaemia is recommended at all times, but not too much vitamin C. Long-term intravenous nutrition in cancer patients can be justified, and hospital nutrition teams are probably cost-effective.
Nutritional support in the premature newborn

Puntis JW.

Abstract

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The theory and practice of nutritional support in the premature newborn has assumed increasing importance with survival of greater numbers of very immature infants. After birth, many do not tolerate full enteral feeding until gastrointestinal motor function has matured. During this process some will develop necrotising enterocolitis (NEC), a devastating failure of adaptation to postnatal life that may result in death, or severe complications. The feeding strategy that minimises the risk of NEC remains to be defined. In addition, promoting growth rates and nutrient accretion equivalent to those achieved during fetal development while optimising neurodevelopmental and long term health outcomes represents an important challenge for neonatologists. This review will focus on the problems associated with enteral nutrition, the requirement for parenteral nutrition, and the long term consequences of early nutritional interventions, underlining the need for prolonged follow up in assessing the potential benefits of different approaches to feeding.

Optimal timing for intravenous administration set replacement

Gillies D, O’Riordan L, Wallen M, Morrison A, Rankin K, Nagy S.

Abstract

BACKGROUND: Administration of intravenous therapy is a common occurrence within the hospital setting. Routine replacement of administration sets has been advocated to reduce intravenous infusion contamination. If decreasing the frequency of changing intravenous administration sets does not increase infection rates, a change in practice could result in considerable cost savings. OBJECTIVES: The objective of this review was to identify the optimal interval for the routine replacement of intravenous administration sets when infusate or parenteral nutrition (lipid and non-lipid) solutions are administered to people in hospital via central or peripheral venous catheters. SEARCH STRATEGY: We searched The Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, CINAHL, EMBASE: all from inception to February 2004; reference lists of identified trials, and bibliographies of published reviews. We also contacted researchers in the field. We did not have a language restriction. SELECTION CRITERIA: We included all randomized or quasi-randomized controlled trials addressing the frequency of replacing intravenous administration sets when parenteral nutrition (lipid and non-lipid containing solutions) or infusions (excluding blood) were administered to people in hospital via a central or peripheral catheter. DATA COLLECTION AND ANALYSIS: Two authors assessed all potentially relevant studies. We resolved disagreements between the two authors by discussion with a third author. We collected data for the outcomes; infusate contamination; infusate-related bloodstream infection; catheter contamination; catheter-related bloodstream infection; all-cause bloodstream infection and all-cause mortality. MAIN RESULTS: We identified 23 references for review. We excluded eight of these studies; five because they did not fit the inclusion criteria and three because of inadequate data. We extracted data from the remaining 15 references (13 studies) with 4783 participants. We conclude that there is no evidence that changing intravenous administration sets more often than every 96 hours reduces the incidence of bloodstream infection. We do not know whether changing administration sets less often than every 96 hours affects the incidence of infection. In addition, we found that there were no differences between participants with central versus peripheral catheters; nor between participants who did and did not receive parenteral nutrition, or between children and adults. AUTHORS’ CONCLUSIONS: It appears that administration sets that do not contain lipids, blood or blood products may be left in place for intervals of up to 96 hours without increasing the incidence of infection. There was no evidence to suggest that administration sets which contain lipids should not be changed every 24 hours as currently recommended.
An update on parenteral lipids and immune function: only smoke, or is there any fire?

Wanten G.

Abstract

PURPOSE OF REVIEW: This paper synthesizes information from recent studies on the modulation of immune responses by lipid emulsions that are applied as part of parenteral nutrition. This issue is especially relevant in light of the high rate of infectious complications and disturbed inflammatory responses in patients receiving this form of nutritional support. RECENT FINDINGS: Studies reporting on novel emulsions based on olive and fish oils, structured lipids or mixed-type emulsions in which various lipid species replace conventional long-chain triglycerides indicate that these lipids are generally well tolerated. While long-chain triglycerides may promote inflammation due to conversion of n-6 polyunsaturated fatty acids into arachidonic acid-derived eicosanoids, structured lipids and olive oil emulsions appear more immune-neutral. Leukocyte-activating effects of medium-chain triglycerides in experimental studies await further characterization in vivo. A body of evidence shows that immune modulation by fish oil emulsions is essentially anti-inflammatory in nature. This is in line with the observation that n-3 polyunsaturated fatty acids in fish oil replace arachidonic acid in cell membranes as an eicosanoid substrate, resulting in a decreased production of pro-inflammatory mediators. Importantly, recent investigations indicate beneficial effects of parenteral fish oil on relevant clinical outcome measures. SUMMARY: The characteristics of, and mechanisms behind, the effects of various parenteral lipids on immune function are becoming increasingly well understood. The practical relevance of many of these findings is not immediately clear, however, and will have to be substantiated in adequately powered trials before we can translate these findings into a tailored approach for specific clinical situations.

Total parenteral nutrition-associated hyperglycemia correlates with prolonged mechanical ventilation and hospital stay in septic infants

Alaedeen DI, Walsh MC, Chwals WJ.

Abstract

PURPOSE: We studied the effects of total parenteral nutrition (TPN)-associated hyperglycemia on the clinical outcome in premature septic infants in the neonatal intensive care unit. METHODS: The charts of all premature infants weighing less than 1500 g upon admission to the neonatal intensive care unit between January 1, 2002, and December 31, 2002, with sepsis, ventilator dependence, and feeding intolerance were studied. Maximum serum glucose concentrations were compared with duration of TPN, mechanical ventilation, hospital length of stay, and survival using Pearson regression analysis and Student's t test. RESULTS: Thirty-seven patients met the search criteria. The average caloric intake for all infants at the time of blood culture-proven sepsis was 83 +/- 19 kcal/kg per day. The maximum serum glucose concentration (milligrams per deciliter) after having positive blood cultures (sepsis) was positively correlated with the duration of TPN (r = 0.45, P = .005), length of dependence on mechanical ventilation (r = 0.45, P = .006), and hospital length of stay (r = 0.36, P = .03). The average maximum serum glucose level was significantly higher in the nonsurviving infants (241 +/- 46 vs 141 +/- 48, P < .0001). CONCLUSION: Hyperglycemia correlated with prolonged ventilator dependency and increased hospital length of stay in premature septic infants. Avoidance of excessive nutrient delivery and tight glycemic control during periods of acute metabolic stress may improve outcome in this patient population.
Multiple-factor analysis of weight gain in very low birth weight infants

Wu YJ, Yu JL, Gu R.

Abstract
OBJECTIVE: To investigate the correlative factors of weight gain in very low birth weight infants (VLBW).
METHODS: Fifty-one cases of VLBW from July 1998 to March 2004 were analyzed retrospectively.
RESULTS: Twenty two cases were small for gestational age (SGA) and 29 cases were appropriate for gestational age (AGA). The age of first feeding was (2.35 +/- 2.29) d. Caloric intake was (377.61 +/- 121.50) kJ/(kg.d) [(90.25 +/- 29.04) kcal/(kg.d)] and protein intake was (2.18 +/- 0.83) g/(kg.d). The age of birth weight regained was (7.41 +/- 3.57) d and the velocity of weight gain was (16.38 +/- 9.29) g/d or (12.63 +/- 7.15) g/(kg.d). Single factor analysis found that early feeding and caloric supply and protein supply had significant influence on weight gain (P < 0.05). The result of multivariate linear analysis showed that the significant risk factors were associated with supply of calorie and protein. The equation was Y (weight gain) = -6.426 + 0.120X(1) (caloric supply) + 3.737X(2) (protein supply) (P < 0.01). The caloric supply of the cases that achieved the nutritional goal was (468.19 +/- 67.11) kJ/(kg.d), [(111.90 +/- 16.04) kcal/(kg.d)], and that with enteral nutrition and partial parenteral nutrition was [(520.62 +/- 21.59) kJ/(kg.d), [(124.43 +/- 5.16) kJ/(kg.d), (451.49 +/- 68.41) kJ/(kg.d), [(107.98 +/- 16.35) kJ/(kg.d)] respectively. There was significant difference between the two groups (P < 0.05). The mean rank of time of birth weight regaining, the time in hospital stay and duration of parenteral nutrition providing at least 75% of the total daily fluid volume was 18.58, 20.24 and 20.11 in the group of early feeding, and it was 33.00, 32.48 and 31.83 in the group of late feeding, respectively. There were significant differences between the two groups (P < 0.05).
CONCLUSION: Sufficient supply of calorie and protein should be ensured in VLBW infants, especially in SGA and severely ill infants. It was very important to feed VLBW infants as early as possible, which could improve feeding tolerance and gastrointestinal maturation. VLBW infants should receive parenteral nutrition as supplements to enteral feeding.

Parenteral N-3 fatty acids modulate inflammatory and immune response in rats undergoing total gastrectomy

Lin MT, Yeh SL, Yeh CL, Lai YN, Chang KJ, Lee PH, Chen WJ.

Abstract
This study investigated the effect of n-3 fatty acid (FA)-containing parenteral nutrition on the circulatory lymphocyte subpopulation, intracellular cytokine and leukocyte adhesion molecule expression, and phagocytic activity in rats undergoing total gastrectomy. Normal rats with internal jugular catheters were assigned to normal control (NC) and two experimental groups and received total parenteral nutrition (TPN). At the same time, a total gastrectomy was performed in the experimental groups, whereas the NC group underwent a sham operation. The TPN solutions were isonitrogenous and identical in nutrient compositions except for differences in fat emulsion contents. The NC and one of the experimental groups received a soybean oil emulsion (SO), and the other experimental group received 50% soybean oil and 50% fish oil emulsion (FO). Half of the rats in each respective group were sacrificed 1 or 3 days after surgery or the sham operation to examine their immune response. The results showed that the FO group had a higher CD4 proportion and CD4/CD8 ratio than those of the SO and NC groups postoperatively. The phagocytic activity of peritoneal macrophages was higher in the FO group than in the NC group, but no difference was found between the SO and NC groups 3 days after surgery. The intracellular interferon (IFN)-gamma distribution in the FO group was higher than that of the SO group on postoperative days. Leukocyte adhesion molecule expressions and peritoneal monocyte chemotactic protein-1 levels were lower in the FO group than in the SO group on postoperative days. Peritoneal macrophage adhesion molecule expression in rats with total gastrectomy.
Ursodeoxycholic acid therapy for intractable total parenteral nutrition-associated cholestasis in surgical very low birth weight infants


Abstract

Introduction: Cholestasis associated with long-term total parenteral nutrition (TPN) occurs commonly in very low birth weight (VLBW) infants. Indeed, the majority of infants with TPN-associated cholestasis (TPNAC) respond very well to TPN withdrawal and full enteral feeding, yet some of them do not respond and have the potential for development of intractable cholestasis. It has been demonstrated that ursodeoxycholic acid (UDCA) has beneficial effects in treating TPNAC in various age groups. Nevertheless, the clinical data of UDCA use in VLBW infants, the most vulnerable group, are limited. We report the results of administration of UDCA therapy to VLBW infants with intractable TPNAC. Methods: Medical records of VLBW infants who were treated with oral UDCA, at dose of 15-20 mg/kg/day, for intractable TPNAC were reviewed from 1999-2001. Treatment effectiveness was evaluated by monitoring the biochemical hepatic markers, including total bilirubin, direct bilirubin, alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma-glutamyl transferase (GGT). Results: A total of 13 infants were identified with the diagnosis of intractable TPNAC and they were treated with UDCA therapy. There was a significant reduction in serum levels of direct bilirubin, total bilirubin (p-value equals 0.0001) and AST (p-value equals 0.001). However, the serum levels of ALP, ALT and GGT showed a trend of improvement, yet none of them was statistically significant. Serum direct bilirubin was noted as the first marker to respond to UDCA therapy. It declined steadily during the course of therapy except in two intervals at the sixth and twelfth week of therapy that apparently associated with severe sepsis. There were no serious side effects noted. Conclusion: Our series data suggest that UDCA is safe and may be a potential treatment for intractable TPNAC if used within two weeks after TPN withdrawal and full enteral feeding. Sepsis may alter the effectiveness of UDCA therapy.
Heparin for prolonging peripheral intravenous catheter use in neonates

Shah PS, Ng E, Sinha AK.

Abstract

BACKGROUND: Peripheral intravenous (PIV) catheters are widely used in modern medical practice. However, mechanical or infectious complications often necessitate their removal and/or replacement. Heparin has been shown to be effective in prolonging the patency of peripheral arterial catheters and central venous catheters, but may result in life threatening complications, especially in preterm neonates. OBJECTIVES: The primary objective was to determine the effectiveness of heparin versus placebo or no treatment on duration of PIV catheter patency, defined as number of hours of catheter use. The secondary objectives were to assess the effects of heparin on catheter blockage, phlebitis or thrombophlebitis, catheter related sepsis, and complications including abnormality of coagulation profile, allergic reactions to heparin, heparin induced thrombocytopenia, intraventricular/intracranial hemorrhage and mortality. SEARCH STRATEGY: A literature search was performed using the following databases: MEDLINE (1966-February 2005), EMBASE (1980-February 2005), CINAHL (1982-February 2005), Cochrane Central Register of Controlled Trials (CENTRAL, The Cochrane Library, Issue 1, 2005), and abstracts from the annual meetings of the Society for Pediatric Research, American Pediatric Society and Pediatric Academic Societies published in Pediatric Research (1991-2004). No language restrictions were applied. SELECTION CRITERIA: Randomized or quasi-randomized trials of heparin administered as flush or infusion versus placebo or no treatment were included. Studies which included a neonatal population and reported on at least one of the outcomes were included. DATA COLLECTION AND ANALYSIS: The methodological quality of the studies was assessed using criteria for blinding of randomization, blinding of intervention, completeness of follow-up and blinding of outcome assessment. Data on relevant outcomes were extracted and the effect size was estimated by calculating WMD (weighted mean difference, 95% CI), RR (relative risk, 95% CI) and RD (risk difference, 95% CI). MAIN RESULTS: Ten eligible studies were identified. Heparin was administered either as a flush solution, or as an additive to the total parenteral nutrition solution. Five studies reported data on the duration of use of the first catheter. Two of these studies found no statistically significant effect of heparin; two studies showed a statistically significant increase and one study showed a statistically significant decrease in the duration of PIV catheter use in the heparin group. The results were not combined for meta-analysis due to significant heterogeneity of the treatment effect (p < 0.01). In addition, there were marked differences between the studies in terms of the methodological quality, the dose, the timing, the route of administration of heparin and the outcomes reported. From a limited number of studies, there were no significant differences between the heparin and the placebo/no treatment groups in the risks of infiltration, phlebitis and intracranial hemorrhage. AUTHORS’ CONCLUSIONS: Implications for practice: The effect of heparin on the duration of peripheral intravenous catheter use varied across the studies. Because of clinical heterogeneity and heterogeneity in treatment effect, recommendations for heparin use in neonates with PIV catheters cannot be made. Implications for research: There are insufficient data concerning the effect of heparin for prolonging PIV catheter use in neonates. Further research on the effectiveness, the optimal dose, and the safety of heparin is required.
In-line filters in central venous catheters in a neonatal intensive care unit


Abstract
Nosocomial sepsis remains an important cause of morbidity in neonatal intensive care units. Central venous catheters (CVCs) and parenteral nutrition (TPN) are major risk factors. In-line filters in the intravenous (IV) administration sets prevent the infusion of particles, which may reduce infectious complications. We randomized infants to in-line filter (for clear fluids and lipid emulsions) or no filter placement. Sepsis, nursing time and costs were assessed. IV sets without filters were changed every 24 h, IV-sets with filters every 96 h. Of 442 infants with a CVC, 228 were randomized to filter placement, 214 to no filter. No differences were found in clinical characteristics, CVC-use, and catheter days. Nosocomial sepsis occurred in 37 (16.2%) infants with filters, in 35 (16.3%) in the group without filter (NS). Nursing time to change the IV-administration sets was 4 min shorter in the filter-group (P<0.05). Costs of materials used were comparable. In conclusion, the incidence of sepsis when using filters was not reduced but the nursing time for changing the intravenous sets was reduced without a difference in costs.

Evidence-based practice in the management of vascular access devices for home parenteral nutrition therapy


Abstract
Catheter-related bloodstream infection and catheter occlusion are potential significant complications of parenteral nutrition therapy. The increased incidence and associated morbidity, mortality, increased costs, and quality-of-life issues experienced with these adverse events necessitate specialized management of vascular access devices. The host coagulation response to biomaterials and the associated development of biofilm on vascular devices are complex phenomena. Multiple interventions are required to prevent access of bacteria to both intraluminal and extraluminal catheter surfaces, and the occurrence of catheter occlusion. The discovery of the biofilm form of microbial life and the associated recalcitrance of biofilm bacteria to antimicrobials has provided insight into the failure of current prevention, diagnostic, and treatment protocols. Critical interventions are presented correlating current evidence with new discoveries in pathogenesis.
Treatment of catheter occlusion in pediatric patients

Kerner JA Jr, Garcia-Careaga MG, Fisher AA, Poole RL.

Abstract
A proper initial assessment of catheter occlusion is the key to successful management. The assessment screens are for both thrombotic and nonthrombotic causes (including mechanical occlusion). If mechanical occlusion is excluded, thrombotic occlusion is treated with alteplase. Nonthrombotic occlusions are treated according to their primary etiologies: lipid occlusion is treated with 70% ethanol, mineral precipitates are treated with 0.1-N hydrochloric acid (HCl), drug precipitates are treated according to their pH-acidic drugs can be cleared with 0.1-N HCl, basic medications can be cleared with sodium bicarbonate or 0.1-N sodium hydroxide (NaOH).

Prevention of occlusion of central venous access devices is also critical. To date, no data conclusively show heparin flushes to be superior to saline flushes. No prophylactic regimen, including low-dose warfarin, low-molecular-weight heparin, or 1 unit heparin/mL of parenteral nutrition has been endorsed by any major medical, nursing, or pharmacy group due to lack of scientific evidence. The most encouraging information on decreasing occlusion rate comes from experience with positive-pressure devices that attach to the hub of most catheter lumens and prevent retrograde blood flow and, consequently, decrease the risk of thrombus formation in the catheter lumen.

Dysfunction and thrombotic complications of vascular access devices

Steiger E.

Abstract
Catheter dysfunction occurs frequently in patients receiving home parenteral nutrition (HPN). Catheter-associated thrombosis can be life threatening and limit future vascular sites. Both of these complications can be minimized and treated by proper catheter placement and being aware of preventative and therapeutic measures.
A retrospective chart review of risk factors for extravasation among neonates receiving peripheral intravascular fluids

McCullen KL, Pieper B.

Abstract
PURPOSE: To identify variables associated with extravasation and resulting tissue damage in neonates with peripheral intravascular therapy. DESIGN: A retrospective chart review was completed. SETTING AND SUBJECTS: Randomly selected medical records of 25 neonates admitted to a neonatal intensive care unit from January 2003 through April 2004 and who experienced peripheral intravascular infiltration were examined. INSTRUMENTS: The Neonatal Tissue Extravasation Tool was created to reflect common descriptive variables of the neonatal population and infused solutions used in their care. Tissue damage was classified with the scale from the Task Force of Pediatric Nursing Research Committee, 1994. RESULTS: Charts of 15 female and 10 male infants 24 to 39.6 weeks old were reviewed. Extravasation was not significantly related to age, weight, or sex. The most common intravenous medications were total parenteral nutrition (n = 19) and calcium (n = 18). Peripheral intravenous sites were secured with tape. The sites of the infiltrate were the arm (n = 16), foot/leg (n = 5), and scalp (n = 3) (one not recorded). Stages 0 (absence of redness, pain, swelling; flushes with ease) (n = 11) and 4 (severe swelling; blanching, pain, skin breakdown, etc.) (n = 6) were the most common stages. The site of the infiltrate was measured and care described in only 9 neonates. CONCLUSIONS: The intravascular solutions causing the most extensive damage from extravasation were similar to those reported in other studies. No other potential risk factors were identified, but poor documentation about the extravasation site and management of skin damage hampered data collection via retrospective chart review.

Vascular access in the adult home infusion patient

Sands MJ.
JPEN J Parenter Enteral Nutr. 2006 Jan-Feb;30(1 Suppl):S57-64.

Abstract
The dependence of IV hyperalimentation programs on the achievement and maintenance of reliable vascular access in the home infusion patient population has necessitated a review of the current methods used to establish and maintain adequate long-term vascular access. Vascular access device-related complications are significant contributors to the medical course and costs associated with the care of home parenteral nutrition (HPN) patients. The purpose of this manuscript is to review current thoughts on the establishment of long-term vascular access for HPN with regard to techniques used, device selection, and associated complications.
Intestinal failure-associated liver disease develops in 40% to 60% of infants who require long-term total parenteral nutrition (TPN) for intestinal failure and 15% to 40% of adults on home parenteral nutrition. The clinical spectrum includes hepatic steatosis, cholestasis, cholelithiasis, and hepatic fibrosis. Progression to biliary cirrhosis and the development of portal hypertension and liver failure occurs in a minority but is more common in infants and neonates than in adults. The pathogenesis is multifactorial. In infants it is related to prematurity, low birth weight, duration of PN, short bowel syndrome requiring multiple laparotomies, and recurrent sepsis. Other important mechanisms include lack of enteral feeding, which leads to reduced gut hormone secretion; reduction of bile flow and biliary stasis, which leads to the development of cholestasis; and biliary sludge and gallstones, which exacerbate hepatic dysfunction. In adults, IFALD is less common and related to age, length of time on PN, total caloric intake, and lipid or glucose overload. In preterm infants, a deficiency of taurine or cysteine may play a role, whereas in both adults and children, choline deficiency may exacerbate IFALD. Lipid emulsions, choline deficiency, and manganese toxicity are associated with both hepatic steatosis and cholestasis in adults and children. Management strategies for the prevention of intestinal failure-induced liver disease include early enteral feeding, a multidisciplinary approach to the management of parenteral nutrition, and aseptic catheter techniques to reduce sepsis. The addition of choline, taurine, and cysteine to PN solutions may also play a role. Oral administration of ursodeoxycholic acid may improve bile flow and reduce gallbladder stasis. Survival after either isolated small bowel or combined liver and small bowel transplantation is approximately 50% at 5 years, making this an acceptable therapeutic option in adults and children with irreversible liver and intestinal failure.


Abstract

Intestinal failure-associated liver disease develops in 40% to 60% of infants who require long-term total parenteral nutrition (TPN) for intestinal failure and 15% to 40% of adults on home parenteral nutrition. The clinical spectrum includes hepatic steatosis, cholestasis, cholelithiasis, and hepatic fibrosis. Progression to biliary cirrhosis and the development of portal hypertension and liver failure occurs in a minority but is more common in infants and neonates than in adults. The pathogenesis is multifactorial. In infants it is related to prematurity, low birth weight, duration of PN, short bowel syndrome requiring multiple laparotomies, and recurrent sepsis. Other important mechanisms include lack of enteral feeding, which leads to reduced gut hormone secretion; reduction of bile flow and biliary stasis, which leads to the development of cholestasis; and biliary sludge and gallstones, which exacerbate hepatic dysfunction. In adults, IFALD is less common and related to age, length of time on PN, total caloric intake, and lipid or glucose overload. In preterm infants, a deficiency of taurine or cysteine may play a role, whereas in both adults and children, choline deficiency may exacerbate IFALD. Lipid emulsions, choline deficiency, and manganese toxicity are associated with both hepatic steatosis and cholestasis in adults and children. Management strategies for the prevention of intestinal failure-induced liver disease include early enteral feeding, a multidisciplinary approach to the management of parenteral nutrition, and aseptic catheter techniques to reduce sepsis. The addition of choline, taurine, and cysteine to PN solutions may also play a role. Oral administration of ursodeoxycholic acid may improve bile flow and reduce gallbladder stasis. Survival after either isolated small bowel or combined liver and small bowel transplantation is approximately 50% at 5 years, making this an acceptable therapeutic option in adults and children with irreversible liver and intestinal failure.
History of vascular access

Dudrick SJ.

Abstract
Milestones in the history of the development of vascular access and the subsequent advances in practical clinical applications of the knowledge, techniques, technology, and experience to the beneficial management of a variety of patients are described. The original achievements are presented and briefly discussed primarily, but not exclusively, in relationship to the successful development of parenteral nutrition (PN). Beginning with the discovery of the circulation of blood, landmark events, resulting from astute observations, experimentation, and ingenious technological advances, are summarized or outlined chronologically over the past 4 centuries, with emphasis on the many recent accomplishments of basic and clinical scientists during the past 6 decades. Brief descriptions of several seminal contributions to safe and effective IV access, management, and therapy acknowledge and recognize the historical highlights that have allowed a complex and potentially hazardous therapeutic modality to evolve into a commonly applied useful adjunct to our current inpatient and outpatient armamentarium. A comprehensive list of references documents the highlights of the development of vascular access for the student of history.

Retrospective study of the total insertion period of peripherally inserted central catheter: Discussion of anti-thrombogenic surface and other biomaterial requirements

Leung TK, Chang CP, Lee CM, Shen LK.

Abstract
A retrospective study of patients' records on reviewing the purpose of venous catheter insertion (chemotherapy, blood transfusion, antibiotics or parenteral nutrition); total period of insertion; reason for catheter removal. 120 admitted patients who received fluoroscopic guide PICC (4-French single lumen silicone rubber catheter) insertions into distal SVC via antecubital region of forearm. We retrospectively review human factors including the patients' laboratory data of pre- and post-insertion, total insertion period and reasons for withdrawal. The important human factors that affect the clinical outcome of PICC were also evaluated. The results indicated that the most common complications were wound oozing, phlebitis, occlusion, infection and leaking. Persistent wound oozing for over 3-day-period is the higher incidence of complication. It also demonstrated a surprisingly high ratio (>77%) in those patients with thrombocytopenia and leukemia. In this group, persistent low platelet counts could be noted, the ratio of failure (remove PICC within 3 days) is 10% and there is 40% decrease insertion period (<30 days). Prospectively, it is worthwhile to choose new material or new technology of surface coating of PICC, to decrease consumption of platelet thrombogenic proteins and to maintain normal coagulate function of human bodies.
Use of ready-to-use (RTU) products in home-based parenteral nutrition


Nutr Hosp. 2006 Jan-Feb;21(1):64-70.

Abstract

AIMS: To analyze the real possibility to use ready-to-use multichamber bags for total parenteral nutrition in adult patients on home parenteral nutrition. METHODS: In June 2005 we studied the adult patients on home parenteral nutrition treatment controlled by the Nutritional Support Unit from an University Hospital. Demographic data, data relating to underlying disease state; infusion regimen and the necessity to modify it; body mass index, fat free mass index, and Karnofsky index evolution, and complications related to parenteral nutrition were assessed. RESULTS: At the time of the study, 8 patients aged 48.9 +/- 17.7 years, were on home parenteral nutrition. The artificial nutrition treatment was administered due to short-bowel syndrome (2); motility disorders (2); suboclusion (2); rapid intestinal transit (1), and malabsorption syndrome (1). With the exception of the patient who started more recently the treatment, all the others needed changes in the parenteral nutrition treatment (number of days for week, or formula modification). In general, both the body mass index and the fat free mass index increased during the treatment. The Karnofsky index was maintained or increased. In relation to catheter-related infection, 4 episodes were observed (0.85/1.000 d of HPN). CONCLUSIONS: Due to the effectiveness, safety and the diversity of multichamber bags available for parenteral nutrition, and the few complications observed in the patients studied, although more studied are necessary, our results suggest that we can use this commercial bags for adult patients on home parenteral nutrition.

Frequency of under- and overfeeding in mechanically ventilated ICU patients: causes and possible consequences

Reid C.


Abstract

INTRODUCTION: In critically ill patients enteral nutrition (EN) is frequently associated with underfeeding and intolerance, whilst parenteral nutrition (PN) has been associated with a greater risk of infectious complications and overfeeding. MATERIALS AND METHODS: The adequacy of nutritional support provided to critically ill patients was prospectively recorded and compared with estimated requirements. The incidence of, and practices contributing to, under- (<80% of energy requirements) and overfeeding (>110% of energy requirements) were identified. RESULTS: Overall patients received approximately 81% and 76% of prescribed energy and protein intakes respectively. Underfeeding occurred on 50.3% of days. Reasons for patients failing to achieve adequate intakes included, fasting for airway management procedures (21%) and gastrointestinal intolerance (14%). Overfeeding, although less common (18.6% of days), was more likely to occur in patients with a tracheostomy requiring prolonged mechanical ventilation (>16 days). The combination of oral and nasogastric feeding or use of nutrient-dense feeds were most frequently associated with overfeeding. Discussion The overall adequacy of nutritional intakes in the present study was similar to those reported elsewhere. However, the incidence of overfeeding was greater than anticipated and occurred in patients already experiencing delayed weaning from mechanical ventilation.
Assessment of activity of care of a nutritional support multidisciplinary team in the follow-up of total parenteral nutrition


Abstract

INTRODUCTION: In total parenteral nutrition (TPN) nutritional support multidisciplinary teams (NSMT) must provide a high quality nutritional assistance based on evidence and daily follow-up of patients with TPN. OBJECTIVES: To assess the degree of adherence to quality standards of care provided to patients on TPN by the NSMT in two consecutive annual periods, according to structure, procedure, and outcomes indicators, previously defined in the team working protocol. PATIENTS AND METHODS: Prospective study of all patients that received TPN at our Center (421-bed general teaching hospital) during the years 2002 and 2003, using the data introduced in NUTRIDATA by daily follow-up of clinical and analytical conditions, and nutritional and non-nutritional complications, comparing both periods and considering an statistical significance level of p < 0.05. RESULTS: One hundred and sixty-three patients and 145 patients received TPN during 2002 and 2003 (65.9% male), respectively, with similar parameters of gender, age, indications for TPN, baseline nutritional status, mean nutritional supply, and non-nutritional complications. As to the different quality indicators established in the comparative study, we found a significant improvement in 2003 vs. 2002 in relation to initial anthropometrical assessment (71.03% vs 51.53%; p < 0.001), initial biochemical assessment (97.93% vs. 92.63%; p < 0.04), performance of systematic monitoring analysis (84.83% vs. 71.78%; p < 0.01), hypernatremia incidence (8.27% vs. 15.34%; p = 0.05) and moderate hyperphosphatemia (26.89% vs. 40.49%; p < 0.02), TPN ending for clinical improvement (76.60% vs. 64.40%; p = 0.04), and reduction of days on TPN (15.74 +/- 20.43 vs. 11.88 +/- 8.34; p < 0.02), the impaired electrolyte levels significantly improving as a whole. We also observed a non-significant trend towards an improvement of adequacy of TPN indications, hyperphosphatemia, severe hypophosphatemia, total stay, and post-surgical stay, in 2003 vs. 2002. CONCLUSIONS: The NSMT experience shows that analysis of indicators based on quality standards, in two successive annual periods allows assessing the improvement of efficiency of nutritional intervention in hospital-admitted patients with TPN with regards to indication, assessment, follow-up, and course.

Home parenteral nutrition: survival, cost, and quality of life

Howard L.


Abstract

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This article summarizes what is known about which factors influence survival of patients on home parenteral nutrition, the costs related to this therapy, and the quality of life for patients living on home parenteral nutrition. The article refers to both North American and European experiences with this complex therapy.
Techniques to prevent central venous catheter infections: products, research, and recommendations

Banton J.

Abstract
Central venous catheters (CVCs) are commonly used to deliver a variety of therapies such as chemotherapy and parenteral nutrition. It is well known that there are complications associated with CVCs; a major complication is catheter-related bloodstream infection (CRBSI). Many strategies exist to prevent CVC complications and CRBSI. This paper will focus on the fight against CRBSI using 3 products at the catheter insertion site: 2% chlorhexidine, BioPatch, and transparent split dressings. Lists of key recommendations from national organizations for infection prevention are included.

Ergonomic and economic aspects of total parenteral nutrition

Genton L, Muhlebach S, Dupupertuis YM, Pichard C.

Abstract
PURPOSE OF REVIEW: Ergonomics in total parenteral nutrition include the work performed in the (hospital) pharmacy and on the medical ward. This article reviews the developments in total parenteral nutrition ergonomics and the related cost-savings. RECENT FINDINGS: Research focuses on the ergonomic advantages of multi-compartment total parenteral nutrition bags compared with the multi-bottle system, of multi versus single-layered total parenteral nutrition bags and of the presence of a nutritional team and training in clinical nutrition to improve regimen prescription and delivery. SUMMARY: Three-compartment bags are safe, economic and ergonomic. It is important, however, to keep the knowledge of pharmacies to compound total parenteral nutrition for children and (adult) patients with specific pathologies. Research is ongoing in the development of bags with more than three compartments, to include for instance vitamins. This necessitates improvements in bag materials and wrapping. Progress can be made regarding total parenteral nutrition prescription and delivery, as well as in the incidence of related infections by promoting training in clinical nutrition and the implementation of a multidisciplinary nutritional support team.
Plasmatic and erythrocytic zinc and copper levels in critically ill patients on parenteral nutrition and their relationship with formulas content: preliminary study


Abstract

OBJECTIVES: To study in severe patients that required parenteral nutrition the relationship between Zn and Cu amounts present in formulas, the clinical course and changes in some biochemical parameters (plasmatic and erythrocytic Zn and Cu levels) during the parenteral nutrition therapy. PATIENTS AND METHODOLOGY: Five adult severe patients were studied, submitted to major abdominal surgery, and that required parenteral nutrition. Determinations were done for: 1) Zinc and copper in parenteral formulas; 2) in patients, at the beginning (T0) and at the end (Tf) of treatment, in erythrocytes: zinc (Zn-E) and cupper (Cu-E); in plasma, zinc (Zn-Pl) and in serum, cupper (Cu-S). Zinc and cupper were determined by means of atomic absorbance spectrometry.

RESULTS: mean +/- standard deviation values and ranges (between brackets) were: parenteral formulas (microg/g): zinc: 0.6 +/- 1.1 (2.2 - 7.0); Cupper: 2.4 +/- 0.7 (0.5-3.7). Biochemical parameters: at T0 (n = 5): Zn-E (microg/mL): 21.6 +/- 10.0 (13.6-36.1); Zn-Pl (microg/dL): 88 +/- 72 (29-205); Cu-E (microg/dL): 113 +/- 22 (60-102); Cu-S (microg/dL): 139 +/- 29 (106 +/- 156); Cu-E (microg/dL): 172 +/- 20 (158-195). Individual values compared to reference ones (normal individual from Buenos Aires with adequate nutrition) indicated that the three patients with favorable course normalized Zn-Pl and Zn-E levels. However, Cu-S increased in the three cases and Cu-E in two of them.

CONCLUSIONS: These results make clear that in the studied patients Zinc levels in parenteral formulas would be adequate to prevent deficiency while Copper levels could be too high.

Of lobsters, electronic medical records, and neonatal total parenteral nutrition

Costakos DT.


Abstract

At the Mayo Health System in LaCrosse, Wisconsin, there are >1000 infant total parenteral nutrition (TPN) orders placed per year. It is the most complicated order that the pharmacy fills, so a recent peer-review article in Pediatrics moved a group of us to action at our center to buy or develop a TPN calculator. We did this because no stand-alone commercial calculators were available to us, and expensive electronic medical records typically do not include TPN calculators for neonatal patients. The new software includes decision support, and the orders are consistently legible. The physician performs fewer calculations, and there are no mathematical errors. This article examines the broader significance of providers having to write their own TPN software.
Role of home parenteral nutrition in chronic radiation enteritis

Gavazzi C, Bhoori S, Lovullo S, Cozzi G, Mariani L.

Abstract

OBJECTIVES: The management of chronic radiation enteritis (CRE) is difficult and often controversial. The aim of the study was to compare long-term outcome of patients with radiation-induced intestinal obstruction treated either surgically or with intestinal rest and home parenteral nutrition (HPN).

METHODS: Thirty patients, with mechanical bowel obstruction due to CRE, were retrospectively included in the study and divided in two groups according to the first treatment approach. Seventeen patients underwent surgery (S group) and 13 patients were supported with HPN (HPN group). Survival, nutrition autonomy, number of surgeries, related complications and persistence of symptoms were evaluated in the two groups. Associations between factors and treatment group were assessed by means of the Wilcoxon rank sum test for continuous variables and the Fisher exact test for categorical variables. Overall survival was calculated using the Kaplan-Meier method.

RESULTS: The two groups were similar in terms of age, dose of radiation therapy, time of occurrence and degree of signs and symptoms. 7/13 patients in the HPN group resolved the obstruction without surgery. 10/17 patients of the S group developed intestinal failure which required HPN. Nutrition autonomy was achieved in 100% and 58.8% of HPN and S group respectively (p = 0.01). The overall five-year survival was 90.0% and 68.4% respectively in the HPN and S group (p = 0.0231).

CONCLUSIONS: Both HPN and surgery are often necessary in patients with chronic radiation-induced intestinal obstruction. However, the long term nutrition autonomy and survival seem to be better in patients initially treated with intestinal rest and HPN.

Clinical application of parenteral nutrition in the treatment of five ponies and one donkey with hyperlipaemia

Durham AE.
Vet Rec. 2006 Feb 4;158(5):159-64.

Abstract

Five ponies and one donkey with hyperlipaemia that occurred secondarily to a variety of primary clinical conditions were treated with lipid-free partial parenteral nutrition comprising equal volumes of 50 per cent glucose and 15 per cent amino acids. The infusion supplied energy and protein at rates of 2.6 kJ/kg per hour and 34.3 mg/kg per hour, respectively. In all six cases there was a prompt and sustained decrease in serum concentrations of triglyceride. In four of the six cases a good response to treatment of the primary condition was also seen and the subjects were discharged successfully. In the remaining two cases, poor clinical response of the primary condition resulted in euthanasia, although hyperlipaemia was nevertheless resolved. The main complication of parenteral nutrition was hyperglycaemia.
Carnitine concentrations in term and preterm newborns at birth and during the first days of life


Abstract
Carnitine plays an important role in energetic metabolism. The aim of the study was to characterize the carnitine status in term and preterm newborns with respect to gestational age, birth weight, haematocrit and red blood cell count (RBC). The effect of nutrition on carnitine levels in the first week of life was also studied. Total blood pool of free carnitine (FC), acylcarnitines (AC) and total carnitine (TC) were analysed in whole cord blood and postnatally in capillary blood obtained at the day 4-6 in 33 term newborns and at the day 7-10 in 27 preterm newborns using tandem mass spectrometry. Plasma level of carnitine in the cord blood was measured using radioenzymatic method. Cord plasma levels of FC, AC and TC were higher in preterm newborns in comparison with term newborns (p < 0.01), but the total blood pool of FC and TC in whole cord blood was lower in preterm newborns than in term newborns (p < 0.01) and positive correlation was found between FC and gestational age or birth weight (p < 0.05). In addition, positive correlation was found between AC and red blood cell count or haematocrit (p < 0.05). During the first week of life, blood pool of FC and TC in term newborns and AC and TC in preterm newborns decreased regardless of the type of enteral or parenteral nutrition. Our results indicate that preterm newborns are born with limited carnitine store. Interpretation of carnitine analyses in whole blood relies in addition to gestational age and birth weight on the haematocrit, especially in newborns with anaemia or blood hyperviscosity.

Causes and management of intestinal failure in children

Goulet O, Ruemmele F.


Abstract
Intestinal failure is a condition requiring the use of parenteral nutrition as long as it persists. Causes of severe protracted intestinal failure include short bowel syndrome, congenital diseases of enterocyte development, and severe motility disorders (total or subtotal aganglionic or chronic intestinal pseudo-obstruction syndrome). Intestinal failure may be irreversible in some patients, thus requiring permanent parenteral nutrition. Liver disease may develop with subsequent end-stage liver cirrhosis in patients with intestinal failure as a consequence of both underlying digestive disease and unadapted parenteral nutrition. Death will occur if combined liver-intestine transplantation is not performed. Catheter-related sepsis and/or extensive vascular thrombosis may impede the continuation of a safe and efficient parenteral nutrition and may also require intestinal transplantation in some selected cases. Thus management of patients with intestinal failure requires an early recognition of the condition and the analysis of its risk of irreversibility. Timing of referral for intestinal transplantation remains a crucial issue. As a consequence, management should include therapies adapted to each stage of intestinal failure based on a multidisciplinary approach in centers involving pediatric gastroenterology, parenteral nutrition expertise, home parenteral nutrition program, pediatric surgery, and liver intestinal transplantation program.
Comparison of hydrogen peroxide and peracetic acid as isolator sterilization agents in a hospital pharmacy

Bounoure F, Fiquet H, Arnaud P.

Abstract
PURPOSE: The efficacy of hydrogen peroxide and peracetic acid as isolator sterilization agents was compared. METHODS: Sterilization and efficacy tests were conducted in a flexible 0.8-m³ transfer isolator using a standard load of glass bottles and sterile medical devices in their packing paper. Bacillus stearothermophilus spores were placed in six critical locations of the isolator and incubated at 55 degrees C in a culture medium for 14 days. Sterilization by 4.25 mL/m³ of 33% vapor-phase hydrogen peroxide and 12.5 mL/m³ of 3.5% peracetic acid was tested in triplicate. Sterility was validated for hydrogen peroxide and peracetic acid at 60, 90, 120, and 180 minutes and at 90, 120, 150, 180, 210, and 240 minutes, respectively. RESULTS: In an efficacy test conducted with an empty isolator, the sterilization time required to destroy B. stearothermophilus spores was 90 minutes for both sterilants, indicating that they have comparable bactericidal properties. During the validation test with a standard load, the sterilization time using hydrogen peroxide was 150 minutes versus 120 minutes with peracetic acid. The glove cuff was particularly difficult for hydrogen peroxide to sterilize, likely due to its slower diffusion time than that of peracetic acid. Hydrogen peroxide is an environmentally safer agent than peracetic acid; however, its bacteriostatic properties, lack of odor, and poor diffusion time may limit its use in sterilizing some materials. CONCLUSION: Hydrogen peroxide is a useful alternative to peracetic acid for isolator sterilization in a hospital pharmacy or parenteral nutrition preparation unit.

Effect of a closed drug-delivery system on the incidence of nosocomial and catheter-related bloodstream infections in infants

Reiter PD, Novak K, Valuck RJ, Rosenberg AA, Fish D.

Abstract
We conducted a prospective, cohort study at two affiliated level III neonatal intensive care units to evaluate the effect of a closed drug-delivery system on the incidence of nosocomial and catheter-related bloodstream infections (CRBSI) in infants. A total of 300 infants (n=150 at each site) were enrolled over a 4-year study period. There was no difference in the rate of CRBSI per 1000 catheter days between the two sites (16.2+/-39 vs. 8.9+/-24, P=0.054, 95% CI:14.8 to 0.13). Infants at site A (closed drug-delivery system) had a higher rate of infectious nosocomial respiratory complications per 100 hospital days than infants at site B (open delivery system) (1.1+/-2.2 vs. 0.5+/-1.5, P=0.009), however, there was no difference in the overall number of confirmed or suspected nosocomial infection events per patient between study sites. Logistic regression revealed that the number of additional peripheral catheters, gestational age and duration of parenteral nutrition all significantly contributed to the risk of developing one or more CRBSI. The closed drug-delivery system failed to reduce the incidence of CRBSI or overall rate of nosocomial infections in premature infants.
Total parenteral nutrition in management of hyperlipidemic pancreatitis during pregnancy

Loh JA, Rickels MR, Williams J, Iqbal N.

Abstract

OBJECTIVE: To describe a case of severe gestational hyperlipidemic pancreatitis successfully managed with minimal-lipid-containing parenteral nutrition (PN) followed by a minimal-fat diet, which resulted in delivery of a healthy full-term neonate. METHODS: We present the case of a young woman with gestational hyperlipidemic pancreatitis whose management included the use of PN during pregnancy. In addition, we review the literature pertaining to the management of hyperlipidemic pancreatitis during pregnancy and discuss the role for PN. RESULTS: A 32-year-old gravida 2, para 1 woman at 27 weeks 3 days of gestation presented with 1 day of nausea, bilious emesis, and severe abdominal pain caused by pancreatitis attributable to hypertriglyceridemia. Her initial serum triglyceride concentration was 9,450 mg/dL. She received fluids intravenously and minimal-lipid PN until resolution of her symptoms. The serum triglyceride level remained less than 850 mg/dL during administration of PN. She subsequently tolerated a minimal-fat diet, while the serum triglyceride level was maintained at less than 1,400 mg/dL, until delivery of a full-term, healthy neonate. CONCLUSION: In severe gestational hyperlipidemic pancreatitis, PN offers a safe and flexible treatment option by providing pancreatic rest and controlling serum triglyceride concentrations while maintaining fetal and maternal nutritional support.

Determinants of insulin availability in parenteral nutrition solutions

Christianson MA, Schwartz MW, Suzuki N.

Abstract

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BACKGROUND: Management of hyperglycemia in patients receiving parenteral nutrition (PN) often includes the addition of regular insulin to the PN solution. A literature review has shown insulin availability in such solutions to range from 10% to 95%. This discrepancy in availability may be due to differences in the composition of the PN solution, the final concentration of insulin, or the assay method used to determine insulin concentrations. The purpose of this study was to evaluate insulin recovery from a standard PN solution used at our medical center. METHODS: Solutions were manually prepared in our pharmacy according to standard practice. Multivitamins and trace elements were added to 1 of 2 L of solution each day. Each of 3 simulated patients received 2 L of solution per day for 3 consecutive days. Samples from each bottle were drawn at baseline, 1 hour after the start of infusion, and 1 hour before the end of infusion and were subsequently analyzed for immunoreactive insulin levels by radioimmunoassay. RESULTS: Recovery of insulin from solutions containing multivitamins and trace elements was much greater (95%) than from those without (5%). CONCLUSIONS: The presence of multivitamins and trace elements is a major determinant of insulin availability in PN solutions. Additional research is necessary to determine the mechanism mediating this effect and to assess its clinical significance.
Reference List


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