Original Article

Early diet intervention to reduce the incidence of hepatic encephalopathy in cirrhosis patients: post-Transjugular Intrahepatic Portosystemic Shunt (TIPS) findings

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Background and Objectives: Hepatic encephalopathy is a common complication in patients who have received transjugular intrahepatic portosystemic shunt (TIPS) as treatment for cirrhosis. The objective of this study was to reduce the incidence of post-TIPS hepatic encephalopathy for these patients via positive diet intervention. **Methods and Study Design:** As a control group, 99 cirrhosis patients who underwent TIPS treatment in our department between August 2011 and February 2013 were chosen. Among these, postoperative hepatic encephalopathy occurred in 28 cases. After analyzing the possible causes and incentives of hepatic encephalopathy by applying retrospective analysis, it was seen that hepatic encephalopathy was caused mostly by improper diet (85.7%). The experimental group was comprised of 83 cirrhosis patients who underwent TIPS treatment during the period from May 2013 to September 2014. In view of the influence of improper diet, appropriate intervention measures were taken, including developing a postoperative nursing routine, training nurses about nutrition and the protein content of kinds of various common foods, customizing low-protein meals, training nurses in communication skills to improve the education of patients and establishing family support systems. **Results:** For the experimental group, hepatic encephalopathy occurred in 10 patients, for an incidence of 12.1%, which is significantly lower than the control group (28.3%). This is a statistically significant difference ($p<0.01$) in the occurrence of this complication. **Conclusions:** After TIPS, early positive dietary intervention can significantly improve the compliance of cirrhosis patients to consume a low-protein diet and reduce the incidence of hepatic encephalopathy.

Key Words: early diet intervention, nutrition, TIPS, hepatic encephalopathy, cirrhosis

INTRODUCTION

Transjugular intrahepatic portosystemic shunt (TIPS) is a non-surgical procedure using a catheter inserted through the jugular vein in order to create an effective channel between the portal vein and hepatic veins. This diverts some of the blood flow from the portal vein directly into the vena cava, reducing portal vein pressure. TIPS is used to reduce portal pressure, control refractory ascites, as a non-surgical method of reduce or control variceal bleeding[1-6] and is commonly used as a palliative therapy for patients waiting for liver transplantation.[4] However, TIPS is frequently complicated by hepatic encephalopathy,[7-10] which often occurs within a 3 month postoperative period.[8] The occurrence of hepatic encephalopathy after TIPS is related to the formation of the new blood flow channel and may be caused by decreased hepatic blood perfusion, leading to a decrease in liver metabolism, and the intestinal absorption of harmful substances that would normally be detoxified by the liver.[2,11,12] The occurrence of hepatic encephalopathy leads not only to a prolonged hospitalization of the patient,[12] but also increases the workload on nursing staff,[1] increases medical care costs,[12,13] and harms the mental and physical well-being of the patient, seriously affecting the prognosis.[1,14-16] In light of these causes and deleterious effects of hepatic encephalopathy, starting in May 2013, our department deployed a program of nursing intervention for patients treated for liver cirrhosis, via TIPS, to reduce the incidence of hepatic encephalopathy. We achieved satisfactory results, compared to previous patient cases without intervention, and our report follows.

MATERIALS AND METHODS

General information

All participants signed written informed consent and the study was conducted according to the principles expressed in the Declaration of Helsinki. The study methods and participants were approved by the Ethics Committee of

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the Second Affiliated Hospital of Chongqing Medical University prior to the beginning of the study.

The control group was selected from patients treated for liver cirrhosis, via TIPS, by our department between August 2011 and February 2013. In total, 99 cases were chosen. Of these, there were 86 cases of cirrhosis from hepatitis B, 10 patients with alcoholic cirrhosis, 2 patients with autoimmune hepatitis and cirrhosis and 1 patient with hepatitis C cirrhosis. Ages ranged from 28 to 71 years of age, with a mean age of 48.2±12.3 years. 82 patients were men (82.8%) and 17 were women (17.2%). Hepatic encephalopathy after TIPS occurred in 28 cases (incidence rate 28.3%), of which 26 cases were in hepatitis B cirrhosis and 2 cases in alcoholic liver cirrhosis. 23 (82.1%) cases of hepatic encephalopathy were Phase I-II and 5 (17.9%) cases were Phase Ⅲ-Ⅳ. 27 hepatic encephalopathy cases (96.4%) were men and 1 case (3.6 %) women.

The experimental group was comprised of 83 patients treated with TIPS between May, 2013 and September, 2014 in our department. Of these, 77 cases were cirrhosis related to hepatitis B, 5 with alcoholic cirrhosis and 1 case of autoimmune hepatitis and cirrhosis. The experimental group ranged in age from 30 to 73 years of age, with a mean age 49.4±14.6 years. 71 were men (85.5%) and 12 were women (14.5%). Postoperative hepatic encephalopathy occurred in 10 cases, all of which were men patients with hepatitis B. 8 cases (80.0%) were Phase I-II encephalopathy and 2 (20.0%) were Phase Ⅲ-Ⅳ. Both groups were selected in line with procedural indications and there were no statistical differences between the age, gender, laboratory test results, grade of liver function or progression of cirrhosis between the control and experimental groups.

Methods

A retrospective analysis was applied to the case histories of the control group of cirrhosis patients, who underwent the TIPS procedure in our department between August 2011 and February 2013. An investigation into the causes and aggravating factors of hepatic encephalopathy (Figure 1) showed that the most common reason (85.7%) for this occurrence was an improper diet following the TIPS procedure. A deeper study of the reasons behind the failure of patients to maintain a low protein diet (Figure 2) revealed that the major cause (~71.0%) was due to lack of adequate education, likely caused by lack of training of and subsequent training by the nursing staff. For purposes of our study, the post-TIPS low protein diet prescribed limited intake of protein, from all sources, to less than 40 g per day.

Development of a postoperative nursing routine

We developed a nursing routine for the postoperative care of TIPS patients. Included in this routine was extensive training of the nursing staff and preparation of reference materials. This program was designed to maintain the nursing staff in close relation to the patients in order to monitor and evaluate the activity, rest and psychological state of the patients. With proper training, the nurses were able to provide guidance in daily life, medication and, especially, strong guidance on the low protein diet. For

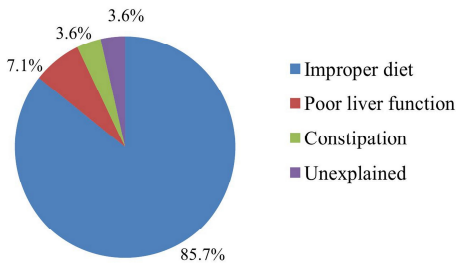

Figure 1. The causes of hepatic encephalopathy in the control group.

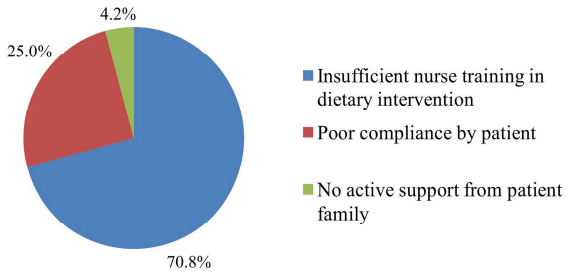

Figure 2. The causes of improper diet in the control group.

the first week after the TIPS procedure, the intake of protein should be strictly limited. For the 3 days immediately following TIPS, protein intake is limited to 20 g/d. After the first week, depending on the nutritional state, tolerance to protein and progress of the patient, the amount of protein in the diet can be adjusted.[17,18] Each 3-5 days, depending on patient progress, an increase of 10 g/d is suggested in order to gradually increase the tolerance to protein. Finally, protein intake should be raised to 0.8-1.0 g/kg/d in order to maintain nitrogen balance.

Nurse training and preparation of reference materials about the protein content of common food ingredients

Working with our Clinical Nutrition Department, we developed a table of the protein content of common food items (per 100 g) for use as a reference by nursing staff and patients (Table 1). Our nursing staff was trained in the protein value of common foods, how to measure and exchange food items and the complementary role of protein. The reference materials were also passed on to family and friends of the patients, in order better to complement the training by nursing staff.

Nurses also undertook intensive study of the relevant TIPS information, particularly dietary knowledge. Skills were developed and tested through simulation scenarios in order to provide life-like interaction situations. Nurses learned and mastered the relevant knowledge and communication skills before tending to the TIPS patients.

Personalized menus for the low-protein diet

Using “Nutrition Star” software, special menus were prepared for the patients after their TIPS procedure. The recipes clearly informed the patient as to what types, quantities and shapes of food they could eat, as well as guiding them in food exchanges. These recipes were tailored to guide patients and their families in order to make simple, easy to prepare meals that were well matched with the patient’s diet, lifestyle and usual cooking methods in

Table 1. Nutritional information for common foods (per 100 g)

Food type	Food names	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)
Cereals and cereal products	Noodles	286	8.3	0.7	61.9
	Hanamaki	214	6.4	1	45.6
	Steamed bread	223	7	1.1	47
	Rice	347	7.4	0.8	77.9
	Glutinous rice	350	7.3	1	78.3
	Fresh corn	112	4	1.2	22.8
	Dry corn	348	8.7	3.8	73
	Millet	361	9	3.1	75.1
	Buckwheat	337	9.3	2.3	73
Potato starch and products	Potato	77	2	0.2	17.2
	Sweet potato	106	1.4	0.2	25.2
	Lotus root starch	373	0.2	…	93
	Vermicelli	339	0.5	0.1	84.2
Dried beans and products	Soy	390	35	16	34.2
	Black beans	401	36	15.9	33.6
	Tofu	82	8.1	3.7	4.2
	Soy milk	16	1.8	0.7	1.1
	Bean Curd	410	44.6	17.4	18.8
	Dry Tofu	142	16.2	3.6	11.5
	Green beans	329	21.6	0.8	62
	Red bean	324	20.2	0.6	63.4
	Broad bean	338	21.6	1	61.5
	Hyacinth bean	339	25.3	0.4	61.9
	Peas	334	20.3	1.1	65.8
Meat and products	Pork (fat and lean)	395	13.2	37	2.4
	Lean pork	143	20.3	6.2	1.5
	Trotter	260	22.6	18.8	0
	Pork bellies	110	15.2	5.1	0.7
	Pig liver	129	19.3	3.5	5
	Pig blood	55	12.2	0.3	0.9
	Bacon	498	11.8	48.8	2.9
	Sausage	508	24.1	40.7	11.2
	Beef	125	19.9	4.2	2
	Lean beef	106	20.2	2.3	1.2
	Beef jerky	550	45.6	40	1.9
	Lamb	203	19	14.1	0
	Lean lamb	118	20.5	1.6	1.6
	Rabbit	102	19.7	2.2	0.9
Poultry and related products	Chicken	167	19.3	9.4	1.3
	Wings	194	17.4	11.8	4.6
	Chicken leg	181	16	13	0
	Palmatum	254	23.9	16.4	2.7
	Duck	240	15.5	19.7	0.2
	Goose	251	17.9	19.9	0
	Pigeon	201	16.5	14.2	1.7
	Quail	110	20.2	3.1	0.2
Dairy and products	Milk	54	3	3.2	3.4
	Milk powder	484	19.9	22.7	49.9
	Yogurt	72	2.5	2.7	9.3
	Cheese	328	25.7	23.5	3.5
	Cream	879	0.7	97	0.9
Eggs and products	Eggs	144	13.3	8.8	2.8
	Duck's egg	180	12.6	13	3.1
	Goose egg	196	11.1	15.6	2.8
	Quail eggs	160	12.8	11.1	2.1
Yuxia shellfish	Grass carp	113	16.6	5.2	0
	Carp	109	17.6	4.1	0.5
	Carp	108	17.1	2.7	3.8
	Eel	89	18	1.4	1.2
	Loach	96	17.9	2	1.7
	Chub	104	17.8	3.6	0

Table 1. Nutritional information for common foods (per 100 g) (cont.)

Food type	Food names	Energy (kcal)	Protein (g)	Fat (g)	Carbohydrates (g)
	Ribbonfish	127	17.7	4.9	3.1
	Sardine	89	19.8	1.1	0
	Sea bass	105	18.6	3.4	0
	Cod	88	20.4	0.5	0.5
	Shrimp	93	18.6	0.8	2.8
	Lobster	90	18.9	1.1	1
	Shrimp skin	153	30.7	2.2	2.5
	Shrimp	198	43.7	2.6	0
	Crab	95	13.8	2.3	4.7
	Crab	62	11.6	1.2	1.1
	Scallops (fresh)	60	11.1	0.6	2.6
	Clams	62	10.1	1.1	2.8
	Screw	100	15.7	1.2	6.6
	Sea cucumber	78	16.5	0.2	2.5
	Cuttlefish	83	15.2	0.9	3.4
	Squid (flooding)	75	17	0.8	0
	Octopus (octopus)	135	18.9	0.4	14
Snack cookies	Cake	348	8.6	5.1	67.1
	Mung bean cake	351	12.8	1	73.4
	Moon cake (nuts)	424	8	16	14
Fast food	Oatmeal	377	15	6.7	66.9
	Biscuit	435	9	12.7	71.7

order to facilitate compliance with the dietary restrictions. Patients were also instructed to keep a daily food diary, recording the details of actual food consumption, in order to provide the nurses with timely and effective protein intake histories. This allowed the nurses to assess the patient's protein intake while monitoring for the occurrence of hepatic encephalopathy.

Assisting patients establish a family - social support network

The family members and friends of patients were organized and educated about the postoperative recovery process. They learned about the adverse effects of a high-protein diet in patients with compromised liver function and the importance of dietary control in post-TIPS recovery. Additional information was shared regarding liver function and they were encouraged to provide the patients with conscious attention, spiritual and psychological support and encourage the patients to actively engage in a low-protein diet according to medical advice.

Evaluation

The metric measured in this study was the incidence of post-TIPS hepatic encephalopathy.

Statistical methods

Data was analyzed using SPSS19.0 statistical software. For general information, the mean ± standard deviation is reported for descriptive statistics. Chi-squared test was used to analyze the incidence of postoperative hepatic encephalopathy.

RESULTS

After applying the methods to the experimental group of patients from May 2013 until September 2014, 10 of the 83 patients (12.1%) developed hepatic encephalopathy, significantly lower than the control group. The difference was statistically significant ($p<0.01$) (Table 2). Analyzing the possible causes and aggravating factors in the 10 cases, improper diet was identified as the cause of 4 cases (40.0%) of hepatic encephalopathy, constituting the single largest cause (Figure 3). Of these cases, 2 were attributed to insufficient training of the nursing staff in guiding and directing the patient, while the remaining 2 cases were caused by patients failing to comply with the instructions.

DISCUSSION

Hepatic encephalopathy is one of the most common post-TIPS complications and is related to pre-TIPS Child-Pugh classification and portosystemic shunt diameter. It can be induced by postoperative hepatic hemodynamic change, an improper amount of protein in the diet and infection. It was observed from cases in both groups that the incidence of hepatic encephalopathy caused by preoperative Child-Pugh classification or use of a portosystemic shunt of over-sized diameter was very low, while most cases of hepatic encephalopathy were associated with improper diet. The majority of cases of hepatic encephalopathy

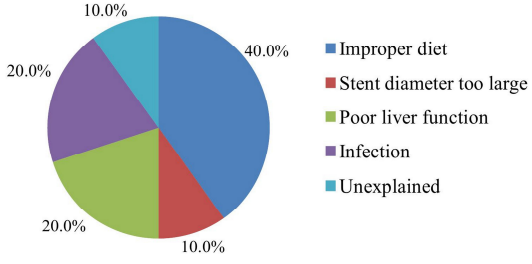

Figure 3. The causes of hepatic encephalopathy in the experimental group.

Table 2. The cases of TIPS patients with hepatic encephalopathy without and with dietary intervention

	Without intervention	With intervention	X^2 value	*p* value
Tips patients	99	83		
Cases of hepatic encephalopathy	28	10	7.20	<0.01
Cases caused by improper diet	24	4	7.94	<0.01

occur within 3 months after the TIPS procedure. This is consistent with relevant reports and highlights the need for early dietary intervention.

Dietary intervention is important for the prevention of postoperative hepatic encephalopathy

Hepatic encephalopathy often occurs in cirrhosis patients within 3 months after the TIPS procedure.[8] In the control group, 85.7% of hepatic encephalopathy cases were caused by improper diet. Therefore, in our experimental group, we took action in the form of dietary intervention to prevent this occurrence in our postoperative TIPS patients. This included developing a TIPS postoperative care routine, creating a reference table of the protein content of common food ingredients and designing personalized menus for low-protein diets. Perhaps most importantly, we developed an intense training program for our nursing staff in order for them to properly learn about dietary requirements and limitations and to develop communication skills to help patients understand their dietary restrictions and to build a family-social support network. The results showed that the incidence of hepatic encephalopathy following our intervention program dropped to 12.1%, substantially better than the 28.3% seen in the control group. Likewise, the development of hepatic encephalopathy attributed to improper diet dropped to 40.0% from 85.7%, suggesting that cirrhosis patients who undergo TIPS necessarily implement dietary restriction, specifically limiting protein intake.

It is essential for the nurses to master knowledge about TIPS and the postoperative diet

Nurses are the missionaries of the low-protein diet and their grasp of the knowledge about the TIPS procedure, especially postoperative diet and care, is requisite and the foundation of patient education. Therefore, prior to caring for such patients, nurses must receive intensive training regarding TIPS and diet. If a nurse does not grasp post-TIPS dietary knowledge, especially regarding the low-protein diet, they cannot fundamentally educate their patients and support networks about dietary restrictions in a comprehensive, scientific, educationally-targeted manner. For example, during the decompensation period, most cirrhosis patients suffer from emaciation. Due to a lack of quality information, their family members consider TIPS as a procedure which consumes the patient's body, and mistakenly assume that eating high-protein foods, such as eggs and meat, is beneficial to the patient's recovery. In fact, in the case of TIPS, the opposite is true. Nurses, equipped with the proper training and knowledge, through detailed and careful education can correct the perceptions of patients and their families, reduce anxiety, and take the initiative with instituting a low-protein diet. At the same time, the nurses can improve their patients' awareness of the disease, and increased awareness and positive behavioral change are positively correlated.

Effective nurse-patient communication will help improve the patient's diet compliance

Nurses, in the daily care activities of patients, are responsible for conditional assessment and treatment functions which require oral communication,[19] so there is a need to strengthen the communication skills of nurses through theoretical knowledge training and exercising their communication skills. When nurses communicate with patients, they must take into account the educational level, the level of disease awareness and the level of health awareness of their patient. This allows them to tailor their communication to the individual, using their communication skills, to ensure that their content is educational, scientific and timely. Specifically related to the low-protein diet, a nurse's knowledge and communication ability are closely related to their patients' compliance on the quantity and timing of protein consumption. In the present study, it was found that if the nurse cannot speak clearly and thoroughly about the importance and necessity of maintaining a low-protein diet, patient compliance will be poor and likely lead to hepatic encephalopathy induced by an improper diet. Descriptive education and effective communication are core elements of the nursing profession,[20] have a major impact on the outcomes of patients with disease,[21] and are critical to the quality of care of patients and their satisfaction with the health care system.[22]

The family - social support system has a significant supervisory role for helping patients to maintain a low-protein diet

Postoperative hepatic encephalopathy generally occurs within the first three months after TIPS, highlighting the importance of maintaining a low-protein diet to mitigate this complication. Nominally, patients will be discharged from hospital care after the TIPS procedure, at varying times based on recovery status. As such, the diet after discharge is typically under the supervision of not only the patient, but also the family and friends. Helping patients establish strong family and social support social support system and educating this network about the treatment and recovery processes, is one of the most effective resources available to patients. In the present study, none of the cases of hepatic encephalopathy in the experimental group were attributable to family-social networks being non-supportive of the patient. This demonstrates that active and effective family - social support systems for patients eating a low-protein diet play a significant role in promoting and monitoring, and thereby increasing, patient compliance and improving the quality of life for patients.

Study limitations

Although we were able to gain valuable insight into some

of the causes of hepatic encephalopathy following TIPS treatment and observed that our process of training and guidance may dramatically improve post-TIPS outcomes, we must address some limitations to our study. Primarily, due to the lack of a diverse large-scale patient base, we were able to analyze only 10 post-TIPS hepatic encephalopathy cases in our experimental group, limiting our ability to draw a statistically relevant conclusion. A large-scale study, perhaps a multi-center collaboration, would allow us better to understand the underlying causes of post-TIPS hepatic encephalopathy and perform more thorough statistical analyses. However, we feel that our program of training, education and close monitoring and mentoring has shown promise as a means to dramatically reduce post-TIPS complications.

Conclusions

After 17 months of observation, the incidence of post-TIPS hepatic encephalopathy in our cirrhosis patients dropped from 28.3% before intervention to 12.1% after intervention, which is a satisfactory result significantly lower than that reported in the practice guidelines of the American Association for the Study of Liver Diseases (AASLD). These results indicate that, after TIPS, early positive diet intervention can significantly improve the compliance of cirrhosis patients to a low protein diet and reduce the incidence of hepatic encephalopathy.

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AUTHOR DISCLOSURES

The authors declare that no conflict of interest exists.

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早期饮食干预可降低肝硬化患者经颈静脉肝内门体分流术（TPIS）术后肝性脑病的发病率

背景与目的：肝性脑病是肝硬化患者经颈静脉肝内门体分流术（TIPS）术后常见的并发症。本研究目的是通过积极的饮食干预降低 TIPS 术后肝性脑病的发病率。**方法与研究设计**：选择 2011 年 8 月至 2013 年 2 月的 99 例接受 TIPS 术治疗的肝硬化患者作为对照组。 其中，术后 28 例并发肝性脑病。采用回顾性研究分析肝性脑病发生的可能原因和诱因，饮食不当为主要诱因，占 85.7%。2013 年 5 月至 2014 年 9 月的 83 例肝硬化 TIPS 术后患者作为实验组，针对饮食不当这一主要问题采取相应的干预措施：制定 TIPS 术后护理常规，培训护士关于营养和常见食物中蛋白质含量的知识，定制低蛋白膳食，培训护士沟通技巧以提高对患者的营养知识教育，帮助建立家庭-社会支持系统。**结果**：实验组中有 10 例发生肝性脑病，发病率为 12.1%，与对照组（28.3%）相比发病率显著降低（p<0.01）。**结论**：早期积极的饮食干预能显著提高肝硬化患者 TIPS 术后低蛋白饮食的依从性，降低肝性脑病的发生率。

关键词：早期饮食干预、营养、TIPS、肝性脑病、肝硬化