Clinical audit on management of hepatic encephalopathy in children admitted to Gastroenterology and Hepatology Unit of Assiut University Children Hospital

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Introduction
Hepatic encephalopathy (HE) is an important metabolic disturbance in children. It is defined as a spectrum of neuropsychiatric abnormalities in patients with liver dysfunction, after exclusion of brain disease.

Patients and methods
A clinical audit on management of HE was applied according to the guideline protocol used in Gastroenterology and Hepatology Unit of Assiut University Children Hospital. The study included 52 children with HE who were admitted to Gastroenterology and Hepatology Unit over 1-year period from the 1st of March 2016 to the 28th of February 2017.

Results
Detailed history intake was recorded in most cases, except history of drug intake, which was not recorded in 23.15% of cases; history of reversal of sleep rhythm, which was not recorded in 17.3% of cases; and history of behavioral changes, which was not recorded in 9.6% of cases. Data of examination were recorded in most cases, except for fetor hepaticus, which was recorded in 42.3% of cases; asterixis, which was recorded in 36.5% of cases; and neurological examination, which was recorded in 91.2% of cases. Basic and mandatory investigations in the diagnosis of HE were done. The standard treatment of HE has been applied except admission to the ICU and prophylactic endotracheal intubation were not applied. Moreover, oral branched-chain amino acids and rifaximin were not given.

Conclusion
The international guidelines for the management of HE have been followed by the Gastroenterology and Hepatology Unit of Assiut University Children Hospital in most treatment lines and that some of the default is owing to poor-resource setting and lack of medication.

Keywords:
children, hepatic encephalopathy, liver disease

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Introduction

Hepatic encephalopathy (HE) is an important metabolic disturbance in children [1]. It is defined as a spectrum of neuropsychiatric abnormalities in patients with liver dysfunction, after exclusion of brain disease [2]. It is characterized by personality changes, intellectual impairment, and a depressed level of consciousness [3]. An important prerequisite for the syndrome is diversion of portal blood into the systemic circulation through portosystemic collateral vessels. HE is also described in patients without cirrhosis with either spontaneous or surgically created portosystemic shunts. The development of HE is explained, to some extent, by the effect of neurotoxic substances, which occurs in the setting of cirrhosis and portal hypertension [4]. The prevention of episodes of HE is an important goal in the treatment of patients with liver disease [5].

Controlling precipitating factors in the management of HE is of paramount importance, because nearly 90% of patients can be treated with just correction of the precipitating factor. Careful attention to this issue is still the cornerstone of HE management [6].

The most important component of managing a child with HE is basic intensive care with regulation of fluid status, glucose, and electrolyte homeostasis. Specific management includes measures to reduce serum ammonia concentrations, prevention, and prompt treatment of complications. Methods to reduce ammonia target various steps in its metabolism. This includes reducing its production and absorption from the intestine and promoting its metabolism in the liver [7].

Aim of the work

The aim is to assess how much the adapted protocols of management of HE were applied at Gastroenterology and Hepatology Unit of Assiut University Children Hospital.

Patients and methods

The present study was conducted in Assiut University Children Hospital on all children with HE admitted to Gastroenterology and Hepatology Unit. The present study included 52 children with HE who were admitted to Gastroenterology and Hepatology Unit of Assiut University Children Hospital over 1-year period from the 1st of March 2016 to the 28th of February 2017. Actually my Master Thesis was a clinical audit that does not need consent statement as all our work was on medical records only.

The following items were taken:

(1) History:
   (a) History of neonatal ICU admission
   (b) History of neonatal jaundice
   (c) History of constipation
   (d) History of gastrointestinal bleeding
   (e) History of vomiting or diarrhea
   (f) History suggestive of systemic infection
   (g) History of drug intake
   (h) History of previous surgery
   (i) History of previous or current liver disease
   (j) History of yellowish discoloration of sclera
   (k) History of change of color of urine or stool
   (l) History of bleeding tendency
   (m) History of convulsion
   (n) History of reversal of sleep rhythm
   (o) History of behavioral changes
   (p) History of disturbance of conscious level

(2) Examination:
   (a) General examination: conscious level, jaundice, pallor, cyanosis, and fetor hepaticus
   (b) Vital signs: pulse, blood pressure, temperature, and respiratory rate
   (c) Upper and lower limb examination: Asterixis (flapping tremors of the hand): lower limb edema
   (d) Chest examination
   (e) Cardiac examination
   (f) Neurological examination
   (g) Abdominal examination: hepatomegaly, splenomegaly, and ascites

(3) Investigations:
   (a) Complete blood count
   (b) Prothrombin time and prothrombin concentration
   (c) Liver function tests
   (d) Kidney function tests and electrolytes
   (e) Blood glucose level
   (f) Blood gases
   (g) Hepatitis markers
   (h) Urine analysis
   (i) Electroencephalography (EEG)
   (j) Abdominal ultrasound
   (k) Blood culture
   (l) Serum ammonia level

(4) Treatment:
   General measures:
      (a) ICU (in grades 3 and 4 HE)
      (b) Insertion of nasogastric tube (in comatosed patients)
      (c) Insertion of urinary catheter
      (d) Prophylactic endotracheal intubation (in severe HE)
      (e) Enemas
      (f) Empirical antibiotics
      (g) Stop gastrointestinal tract bleeding (in cases with gastrointestinal tract bleeding)
      (h) Stop drugs precipitating HE (in cases with history of drug intake)
      (i) Restriction of protein (in case of acute liver failure and inborn error of metabolism)
   Specific measures:
      (a) Lactulose (oral, nasogastric tube, or enema)
      (b) Neomycin
      (c) Metronidazole
      (d) Rifaximin
      (e) L-ornithine L-aspartate (Hepamerz)
      (f) Branched-chain amino acid supplementation
      (g) Zinc 8-L-carnitine.

Results

The present study included 52 children with HE who were admitted to Gastroenterology and Hepatology Unit of Assiut University Children Hospital over 1-year period from the 1st of March 2016 to the 28th of February 2017. A total of 36 cases were males and 16 cases were females with age range from 4 months to 15 years.

Table 1 shows that 69.2% were males and 30.8% were females, with age range from 4 months to 15 years.

Table 2 shows that history of neonatal ICU was recorded in 100% of cases and that 82.7% of cases were asked about history of neonatal jaundice. Regarding history of precipitating factors of HE, most factors were recorded by resident doctors in 100% of cases but history of drug intake was recorded in 76.9% of cases. Overall, 100% of cases were asked about history of previous or recurrent

Table 1 Demographic data of children with hepatic encephalopathy in this study (*n*=52)

Demographic data	*n* (%)
Sex	
Male	36 (69.2)
Female	16 (30.8)
Age (years)	
Range	0.46-15
Mean±SD	5.2±4.6

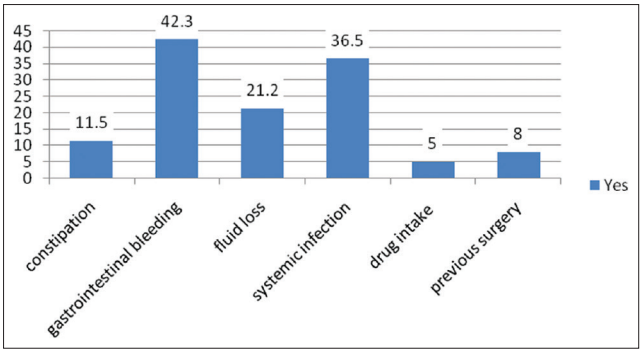
Table 2 History intake of all studied children (*n*=52)

History	Recorded [*n* (%)]	Not recorded [*n* (%)]
History of neonatal ICU admission	52 (100.0)	0 (0.0)
History of neonatal jaundice	43 (82.7)	9 (17.3)
History of constipation	52 (100.0)	0 (0.0)
History of gastrointestinal bleeding	52 (100.0)	0 (0.0)
History of vomiting or diarrhea	52 (100.0)	0 (0.0)
History suggestive of systemic infection	52 (100.0)	0 (0.0)
History of drug intake	40 (76.9)	12 (23.1)
History of previous surgery	50 (96.0)	2 (4.0)
History of previous or current liver disease	52 (100.0)	0 (0.0)
History of fever, anorexia	52 (100.0)	0 (0.0)
History of yellowish discoloration of sclera	52 (100.0)	0 (0.0)
History of change of color of urine or stool	52 (100.0)	0 (0.0)
History of bleeding tendency	52 (100.0)	0 (0.0)
History of convulsion	47 (90.4)	5 (9.6)
History of reversal of sleep rhythm	43 (82.7)	9 (17.3)
History of behavioral changes or abnormal movement	47 (90.4)	5 (9.6)
History of disturbance of conscious level	52 (100.0)	0 (0.0)

liver disease. History suggestive of liver disease such as history of jaundice, yellowish discoloration of urine and stool, and bleeding tendency was fully recorded. Moreover, 82.7% of cases were asked about history of reversal of sleep rhythm and 90.4% of cases were asked about history of convulsion (Figs. 1 and 2, Table 3).

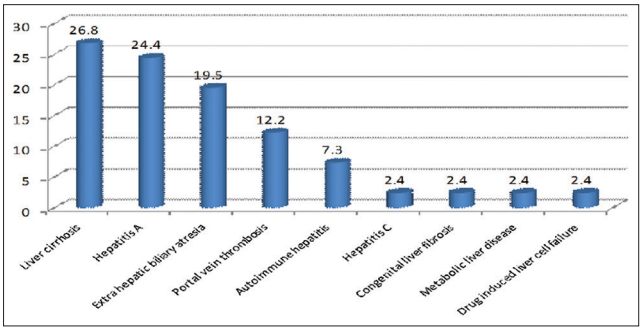
Table 4 shows that assessment of conscious level, general examination, vital signs measurements, upper and lower limb examination, chest examination, and cardiac and abdominal examination were recorded in 100% of cases. Overall, 42.3% of cases were examined for presence of fetor hepaticus, 36.5% of cases were examined for presence of flapping tremors of the hand, and 13.5% of cases were examined for presence of palmar erythema. Neurological examination was recorded in 91.2% of cases (Table 5).

Figure 1



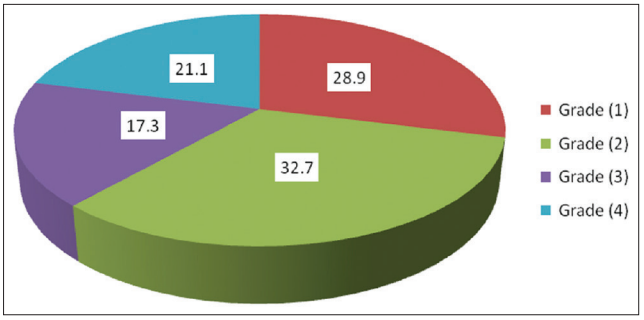
Precipitating factors of hepatic encephalopathy in studied children (overlapping of precipitating factors).

Figure 2



History of previous or current liver disease in studied children (total number = 52).

Figure 3



Grades of hepatic encephalopathy according to West Haven classification in studied children (total number = 52).

Table 6 shows that 28.9% of cases had grade 1 HE, 32.7% of cases had grade 2, 17.3% of cases had grade 3, and 21.1% of cases had grade 4 HE (Fig. 3).

Table 7 shows that complete blood count, prothrombin time, prothrombin concentration, liver function tests, kidney function tests, electrolytes, blood glucose level, blood gases, hepatitis markers, and abdominal ultrasound were done in 100% of cases. Urine analysis was done in 71.2% of cases. EEG was done in six cases, which were the cases that had convulsion. Blood culture was done in 10 cases which were the only indicated

Table 3 Findings of history intake in studied children (recorded)

History	Yes [*n* (%)]	No [*n* (%)]
History of neonatal ICU admission	13 (25.0)	39 (75.0)
Respiratory distress syndrome	4 (30.8)	
Prematurity	2 (15.4)	
Neonatal jaundice	6 (46.2)	
Bleeding from umbilicus	1 (7.6)	
History of neonatal jaundice	13 (30.0)	30 (70.0)
Persistent neonatal jaundice	6 (46.2)	
History of constipation	6 (11.5)	46 (88.5)
History of gastrointestinal bleeding	22 (42.3)	30 (57.7)
Hematemesis and melena	21 (95.4)	
Hematochezia	1 (4.6)	
History of vomiting or diarrhea	11 (21.2)	41 (78.8)
History suggestive of systemic infection	19 (36.5)	33 (63.5)
Gastroenteritis	7 (36.8)	
Lower respiratory tract infection	7 (36.8)	
Upper respiratory tract infection	5 (26.4)	
History of drug intake: valproic acid	2 (5.0)	38 (95.0)
History of previous surgery	4 (8.0)	46 (92.0)
Operation for extrahepatic biliary atresia	2 (50.0)	
Operation for coarctation of the aorta	1 (25.0)	
Splenectomy	1 (25.0)	
History of previous or current liver disease	41 (78.8)	11 (21.2)
Liver cirrhosis	11 (26.8)	
Hepatitis A	10 (24.4)	
Extrahepatic biliary atresia	8 (19.5)	
Portal vein thrombosis (portal hypertension)	5 (12.2)	
Autoimmune hepatitis	3 (7.3)	
Hepatitis C	1 (2.4)	
Congenital liver fibrosis	1 (2.4)	
Metabolic liver disease (galactosemia)	1 (2.4)	
Drug-induced liver cell failure	1 (2.4)	
History of fever and anorexia	30 (57.7)	22 (42.3)
History of yellowish discoloration of sclera	34 (65.4)	18 (34.6)
History of change of color of urine or stool	34 (65.4)	18 (34.6)
History of abdominal distension	34 (77.0)	10 (23.0)
History of bleeding tendency	22 (42.3)	30 (57.7)
History of convulsion	6 (12.6)	41 (87.4)
History of reversal of sleep rhythm	42 (97.7)	1 (2.3)
History of behavioral changes or abnormal movement	47 (100)	0 (0.0)
History of disturbance of conscious level	52 (100)	0 (0.0)

cases (cases that had symptoms or signs suggestive of sepsis). Serum ammonia level was not done in any case (Table 8).

Table 9 shows that no case of grade 3 or 4 HE was admitted to ICU (instead they all were admitted at Gastroenterology Intermediate Care Unit), and no case of them had prophylactic endotracheal intubation. Insertion of nasogastric tube was done in 100% of cases, but insertion of urinary catheter was done in 40 cases.

Table 4 Examination of all studied children (*n*=52)

Examination	Recorded [*n* (%)]	Not recorded [*n* (%)]
Conscious level (frequent monitoring)	52 (100.0)	0 (0.0)
General look (jaundice, pallor, and cyanosis)	52 (100.0)	0 (0.0)
Vital signs (pulse, blood pressure, temperature, and respiratory rate)	52 (100.0)	0 (0.0)
Fetor hepaticus	22 (42.3)	30 (57.7)
Asterixis (flapping tremors of the hand)	19 (36.5)	33 (63.5)
Palmar erythema and spider nevi	7 (13.5)	45 (86.5)
Upper and lower limb examination (LL edema)	52 (100.0)	0 (0.0)
Chest examination	52 (100.0)	0 (0.0)
Cardiac examination	52 (100.0)	0 (0.0)
Neurological examination	48 (91.2)	4 (8.8)
Abdominal examination	52 (100.0)	0 (0.0)

Enemas, empirical antibiotics, lactulose, neomycin, and L-ornithine L-aspartate (Hepamerz) were given in 100% 0f cases. Stopping of gastrointestinal bleeding and stopping of drugs precipitating HE occurred in 100% of indicated cases. Metronidazole was given in 5.8% of cases, branched-chain amino acid supplementation was given in 7.7% of cases, zinc was given in 17.3% of cases, and L-carnitine was given in 4% of cases, but rifaximin was not given at all.

Discussion

Regarding history intake, most data of the history were fulfilled.

Controlling precipitating factors in the management of HE is of paramount importance, because nearly 90% of patients can be treated with just correction of the precipitating factor [6]. Regarding history of precipitating factors of HE in the present study, data about history of constipation, gastrointestinal bleeding, fluid loss, and systemic infection were recorded in 100% of cases except history of drug intake which was recorded in only 76.9% of cases. Rockey *et al.* [8] reported that a careful drug history should include listing of all agents taken, the time period involved, and the quantity or dose ingested. Paracetamol is usually well tolerated in prescribed dose, but overdose is the most common cause of drug-induced liver disease and acute liver failure worldwide [9]. Therefore, it is very important to take in consideration the importance of history of drug intake in children with HE, because HE may be a reversible disease in this condition. It is also important to do health education about the risk of abuse of antipyretics. In the present study, data about history of previous or current liver disease were recorded in 100% of cases. History suggestive of liver cell failure was recorded in 100% of cases. Regarding

Table 5 Findings of examination in the studied children (recorded)

Examination	Yes [*n* (%)]	No [*n* (%)]
Disturbed conscious level	52 (100.0)	0 (0.0)
Mild (GCS=13-15)	25 (48.1)	
Moderate (GCS=9-12)	16 (30.8)	
Severe (GCS=3-8)	11 (21.1)	
Jaundice	34 (64.6)	18 (35.4)
Pallor	16 (30.4)	36 (69.6)
Cyanosis (owing to severe chest disease)	1 (1.9)	51 (98.1)
Pulse		
Tachycardia	25 (48.0)	
Bradycardia	0 (0.0)	
Normal pulse	27 (52.0)	
Temperature		
Hyperthermia	19 (36.5)	
Hypothermia	3 (5.8)	
Normal temperature	30 (67.7)	
Blood pressure		
Hypertension	4 (7.7)	
Hypotension	13 (25.0)	
Normal blood pressure	35 (67.3)	
Respiratory rate		
Tachypnea	22 (42.3)	
Bradypnea	3 (5.7)	
Normal respiratory rate	27 (52)	
Fetor hepaticus	18 (81.7)	4 (18.3)
Asterixis (flapping tremors of the hand)	19 (100.0)	0 (0.0)
Palmar erythema and spider nevi	4 (57.1)	3 (42.9)
Lower limb edema	14 (26.9)	38 (73.1)
Chest examination		
Respiratory distress and fine crepitations	7 (13.3)	
Normal chest examination	45 (86.7)	
Heart examination		
Pansystolic murmur	1 (1.9)	
Normal heart examination	51 (98.1)	
Neurological examination		
Hyperreflexia and hypertonia	13 (27.0)	
Hyporeflexia and hypotonia	15 (31.0)	
Areflexia	11 (23.1)	
Normal reflexes and muscle tone	9 (18.9)	
Hepatomegaly	37 (71.2)	15 (28.8)
Splenomegaly	19 (36.0)	33 (63.5)
Ascites	18 (34.6)	34 (65.4)
Minimal ascites	10 (56)	
Moderate ascites	1 (5.5)	
Massive ascites	7 (38.5)	

GCS, Glasgow coma scale.

Table 6 Grades of hepatic encephalopathy according to West Haven classification in studied children (*n*=52)

Grades of HE	*n* (%)
Grade 1	15 (28.9)
Grade 2	17 (32.7)
Grade 3	9 (17.3)
Grade 4	11 (21.1)

HE, hepatic encephalopathy.

clinical symptoms of HE in the studied cases, history of disturbance of conscious level was recorded in 100% of cases, history of behavioral changes or abnormal movement was recorded in 90.4% of cases, history of reversal of sleep rhythm was recorded in 82.7% of cases, and history of convulsion was recorded in 90.4% of cases (only 12.6% of recorded cases had history of convulsions). In the case of minimal HE, there may not be any obvious clinical changes. However, these patients have subtle changes in personality, which may be reported by caregivers [10]. So, it is important for doctors to realize that HE may not have obvious clinical symptoms such as coma or convulsions, which are very rarely reported in HE but may be as mild as behavioral changes.

Regarding examination, assessment of conscious level, general look, and vital signs was fulfilled well, but fetor hepaticus was not recorded in 57.7% of cases, and this may be owing to resident doctors who are more concerned with diagnosis, grading, and management of HE. The presence of fetor hepaticus is not constant; patients with cirrhosis without HE can have this condition [11].

Data about general and systemic examination (abdominal examination, chest and cardiac examination, and upper and lower limb examination) were fulfilled in 100% of cases except flapping tremors of the hand (asterixis) which was evaluated in 36.5% of cases because assessment of this sign needs cooperative patients, which is not accessible in very young and comatosed children. The recent International Society for Hepatic Encephalopathy and Nitrogen Metabolism consensus uses the onset of disorientation or asterixis as the onset of overt HE [12]. However, asterixis is not pathognomonic of HE because it can be observed in other diseases (e.g. uremia) [10]. Neurological examination was recorded in 91.2% of cases; there was hyperreflexia and hypertonia in 27% of cases, hyporeflexia and hypotonia in 31% of cases, areflexia in 23.1% of cases, and normal reflexes and normal muscle tone in 18.9% of cases. It is important to inform the doctors about the importance of neurological examination in children with HE. Regarding investigations, most recommended investigations were done for all patients except urine analysis, which was done in only 71.2% of cases, and it is recommended to be done in all cases later on. Electrophysiological evaluation of HE is not routine. The EEG may be abnormal in subclinical HE and early stages of HE. It is usually abnormal in late stages of HE [13]. So, EEG has no diagnostic value in HE, and in this study, EEG was performed in six cases which were the cases that had convulsion, and we recommend this to prevent abuse of investigations especially in countries with limited resources like ours. Serum ammonia level was not done in any case

Table 7 Investigations of all studied children (*n*=52)

Investigations	Done [*n* (%)]	Not done [*n* (%)]
Complete blood count	52 (100.0)	0 (0.0)
Prothrombin time and prothrombin concentration	52 (100.0)	0 (0.0)
Liver function tests	52 (100.0)	0 (0.0)
Kidney function tests and electrolytes	52 (100.0)	0 (0.0)
Blood glucose level	52 (100.0)	0 (0.0)
Blood gases	52 (100.0)	0 (0.0)
Hepatitis markers	52 (100.0)	0 (0.0)
Urine analysis	37 (71.2)	15 (28.8)
Electroencephalography in indicated cases (indicated cases=6)	6 (100.0)	0 (0.0)
Abdominal ultrasound	52 (100.0)	0 (0.0)
Blood culture in indicated cases (indicated cases=10)	10 (100.0)	0 (0.0)
Serum ammonia level	0 (0.0)	52 (100.)

Table 8 Findings of investigations in studied children (recorded)

Investigations	*n* (%)
Complete blood count	
WBC	
Range (mean±SD)	2-14.6 (14.23±2.09)
Leukocytosis	20 (38.5)
Leukopenia	4 (7.7)
Normal leukocytic count	28 (53.8)
Hemoglobin level	
Range (mean±SD)	4-13 (9.23±1.74)
Anemia	42 (81.0)
Normal hemoglobin level	10 (19.0)
Platelet count	
Range (mean±SD)	35-857 (272.29±168.85)
Thrombocytopenia	6 (11.5)
Thrombocytosis	7 (13.5)
Normal platelet count	39 (75.0)
Prothrombin time (PT) and prothrombin concentration (PC)	
Impaired PT and PC	39 (75.0)
Normal PT and PC	13 (25.0)
Liver function tests	
Bilirubin level	
Hyperbilirubinemia	34 (65.4)
Normal bilirubin level	18 (34.6)
Liver enzymes (ALT and AST)	
Raised liver enzymes	19 (36.5)
Normal liver enzymes	33 (63.5)
Kidney function tests	
Raised kidney function tests	2 (4.0)
Normal kidney function tests	50 (96.0)
Electrolytes	
Sodium	
Hypernatremia	6 (11.5)
Hyponatremia	8 (15.4)
Normal sodium level	38 (73.1)
Potassium	
Hyperkalemia	7 (13.5)
Hypokalemia	3 (5.8)
Normal potassium level	42 (80.7)
Calcium	
Hypercalcemia	0 (0.0)
Hypocalcemia	11 (21.0)
Normal calcium level	41 (79.0)
Blood glucose level	
Hyperglycemia	8 (15.4)
Hypoglycemia	3 (5.8)
Normal blood glucose level	41 (78.8)
Blood gases findings	
Metabolic acidosis	27 (51.9)
Metabolic alkalosis	0 (0.0)
Respiratory acidosis	4 (7.7)
Respiratory alkalosis	3 (5.8)
Normal blood gases	18 (34.6)
Hepatitis markers	
Hepatitis A virus antibody IgM: +ve	10 (24.4)
Hepatitis C virus antibody: +ve	1 (2.4)
Negative hepatitis markers	41 (73.2)
Urine analysis findings	
Urinary tract infection	8 (21.6)
Normal	29 (78.4)
Electroencephalography findings	
Diffuse encephalopathy	2 (33.0)
Normal electroencephalography	4 (67.0)
Abdominal ultrasound findings	
Hepatomegaly	37 (71.0)
Splenomegaly	19 (36.5)
Ascites	18 (34.5)
Blood culture findings	
Bacterial overgrowth	4 (40.0)
No growth	6 (60.0)

as it is not available in Assiut University Children Hospital, and this will cost the parents and does not add any diagnostic, staging, or prognostic value in HE. This opinion is in accordance to Lockwood [14], who stated that high blood-ammonia levels alone do not add any diagnostic, staging, or prognostic value in HE in patients with chronic liver disease.

Regarding treatment, the international guidelines for the management of HE have been followed by the Gastroenterology and Hepatology Unit of Assiut University Children Hospital in most treatment lines except admission to the ICU, as no case of grade 3 or 4 HE was admitted to ICU (instead they all were admitted at Gastroenterology Intermediate Care Unit). Therefore, prophylactic endotracheal intubation was not applicable.

Previous authors reported that comatosed patients should be admitted to intensive care and endotracheal intubation considered if their airway is compromised [15]. However, this was not applied in this study, and this may be owing to lack of places in ICU because it has limited number of beds that are allocated for patients requiring mechanical

Table 9 Treatment of all studied children (*n*=52)

Treatment	Done [*n* (%)]	Not done [*n* (%)]
Admission to the ICU (grades 3 and 4 hepatic encephalopathy=20)	0 (0.0)	20 (100)
Insertion of nasogastric tube	52 (100.0)	0 (0.0)
Insertion of urinary catheter	40 (76.9)	12 (23.1)
Prophylactic endotracheal intubation (grades 3 and 4 hepatic encephalopathy=20)	0 (0.0)	20 (100.0)
Enemas	52 (100.0)	0 (0.0)
Empirical antibiotics	52 (100.0)	0 (0.0)
Stop GIT bleeding in indicated cases (indicated cases=22)	22 (100)	0 (0.0)
Stop drugs precipitating HE in indicated cases (indicated cases=2)	2 (100.0)	0 (0.0)
Restriction of protein	52 (100.0)	0 (0.0)
Lactulose	52 (100)	0 (0.0)
Neomycin	52 (100)	0 (0.0)
Metronidazole	3 (5.8)	49 (94.2)
Rifaximin	0 (0.0)	52 (100)
L-ornithine L-aspartate (Hepamerz)	52 (100)	0 (0.0)
Branched-chain amino acid supplementation	4 (7.7)	48 (92.3)
Zinc	9 (17.3)	43 (82.7)
L-carnitine	2 (4.0)	50 (96.0)

GIT, gastrointestinal tract; HE, hepatic encephalopathy.

ventilation only. Insertion of nasogastric tube was done in 100% of cases. Enemas, empirical antibiotics, lactulose, neomycin, and L-ornithine L-aspartate (Hepamerz) were given in 100% of cases. Management of precipitating factors of HE was done in 100% of indicated cases. In this study, intravenous branched-chain amino acids were given in 7.7% of cases who need total parenteral nutrition (TPN), but oral branched chain amino acids (BCAAs) were not used at Gastroenterology and Hepatology Unit because they are not available. Unfortunately, infusion of BCAAs was reported to increase venous blood ammonia in most patients with liver failure [16]. So, it is important to have hospital-based formula in Assiut University Children Hospital for different disease management especially oral formulas enriched with BCAA, which is very important for children with chronic liver disease. Zinc administration has the potential to improve hyperammonemia by increasing the activity of ornithine transcarbamylase, an enzyme in the urea cycle [17]. In the present study, zinc was given in 17.3% of cases, and some cases show slight improvement in the physical component. So, it is recommended to use zinc in all children with HE later on. Rifaximin was not used in the present study. Instead another nonabsorbable antibiotic (Neomycin) was used in all cases. Some oral antibiotics such as neomycin are not recommended for long-term use because of nephrotoxicity, ototoxicity, and peripheral neuropathy and are specifically contraindicated in patients with liver disease [18]. Rifaximin added to lactulose is the best-documented agent to maintain remission in patients who have already experienced one or more bouts of HE while on lactulose treatment after their initial episode of HE [19]. So, it is recommended to be subscribed in children with recurrent HE for prevention of HE recurrence as long-term therapy.

Conclusion

The international guidelines for the management of HE have been followed by the Gastroenterology and Hepatology Unit of Assiut University Children Hospital in most treatment lines and that some of the default is owing to poor-resource setting and lack of medication.

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Conflicts of interest

There are no conflicts of interest.

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