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Nutritional Therapy in Adult Patients with Post-corrosive Injuries of Gastrointestinal Tract

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SUMMARY

Introduction. Acute poisonings with corrosive substances may cause serious chemical injuries of the upper gastrointestinal tract, from the mouth to the intestines. They appear as a result of accidental or intentional ingestion of caustic substances and may be found in patients of different ages. The aim of this paper was to present our experience with nutritional support in patients with acute caustic poisonings that hinder normal nutrition. ***Material and Methods.*** This retrospective study included 33 patients with a history of corrosive substances abuse (acids, alkali and chlorine bleach), of both sexes, aged above 14 years. ***Results.*** Follow-up assessment of our patients has shown a considerable weight loss on day 7 ($p<0.001$), day 14 ($p<0.001$), day 21 ($p<0.001$) and day 28 ($p<0.001$) after admission to hospital, which is explained with the severe post-corrosive condition of the patients and hypercatabolic state. ***Conclusion.*** Caustic poisonings are the most severe poisonings in the clinical practice and they are mostly encountered in younger adults. By application of artificial nutritional support we managed to maintain body weight, level of proteins and albumins, nutritional status and nitrogen balance in our patients.

Key words: corrosive poisonings, nutritional therapy, proteins, nitrogen balance.

1. INTRODUCTION

Acute corrosive poisonings may cause serious chemical injuries of the upper gastrointestinal tract, from the mouth to the small intestines. They appear as a result of accidental and intentional ingestion of corrosive substances and are encountered in subjects of different ages. They often result in post-corrosive complications (stenosis) and may lead to death due to perforation or tracheal necrosis. Contrary to corrosive poisonings in children, which are accidental in the majority of cases, poisonings in adults are with attempted or suicidal intent in 90% of the cases (1).

Severity of the chemical burns depends on several factors: nature, quantity and concentration of the corrosive substance, duration of exposure, act of swallowing, presence of food, gastroesophageal reflux, and various previous pathologic conditions in the upper gastrointestinal tract (2).

In contact with acids, the final outcome is the so-called coagulation necrosis while in contact with alkalis, the outcome is the so-called penetrating liquefaction necrosis. Besides local chemical burns, some system effects may appear, including: metabolic acidosis, tubular necrosis and kidney failure, respiratory distress syndrome. Therefore, often in treatment of these poisonings there is a need of control of the breathing, hemodynamic stabilization and intensive monitoring of the patient as a precaution for onset of abdominal and mediastinal perforation (3). If there is no absolute contraindication urgent esophagogastroduodenoscopy (EGD) has to be done in the first 12-24 hours after caustic ingestion since many authors think the healing is most intensive between 5-15 day following ingestion and the risk for iatrogenic perforation is highest in this interval. Classification of post-corrosive injuries in five grades is done according to Kikendal's scale (4).

During urgent esophagogastroduodenoscopy in patients with grade II B injury according to Kikendal nasojejunal tube is advised to be inserted. On the other hand, in patients with grade III injury jejunostoma or gastrojejunostama is to be inserted because of the high percentage of post-corrosive stenosis and need of long-term artificial nutritional support. In all patients nutritional support starts with total parenteral nutrition and continues per os or with enteral nutrition. In patients with grades I and II A injuries, total parenteral nutrition is practiced in the first 48 hours and is followed by liquid diet by mouth until the 10^{th} day (5). There are controversies and different opinions regarding the use of corticosteroids and antibiotics in the therapy of corrosive intoxications. Risk for onset of esophageal or gastric cancer in patients with caustic poisonings is 1000-fold higher than in the general population (6).

The aim of this study was to present our experience with nutritional therapy in patients with acute caustic poisonings, in whom normal nutrition was hindered due to extensive damage of the gastrointestinal tract. In no time, these patients are into a severe general condition because of the

nutritional status impairment, hyperctabolic condition and a negative nitrogen balance.

2. MATERIAL AND METHODS

This retrospective study included 33 patients with a history of abuse of corrosive substances (acids, alkali and chlorine bleach), of both sexes, aged above 14 years, who were hospitalized and treated at the University Clinic of Toxicology in Skopje, Republic of Macedonia in the period 2008-2009. The study comprised only patients who, following urgent esophagogastroduodenoscopy, had a post-corrosive damage of the upper gastrointestinal tract of grade II B and III according to Kikendal's classification. Patients with grade I and II A were excluded from the study they received food by mouth after 48 hours of parenteral nutritional support. Patients with grade IV injury were also excluded since they were immediately referred to the Surgical Clinic for surgical intervention.

Esophagogastroduodenoscopy was done by experts with an upper GI endoscope, type Olimpus (Japan), with a diameter of 9.2 mm. For easier procedure accomplishment, xylocaine gel was used for local anesthesia of the patients. During esophagogastroduodenoscopy insufflation and retrovisual methods were performed very carefully or were avoided if patients were with more severe clinical presentation. Severity of post-corrosive injuries was graded using the Kikendal's classification of 5 grades. Within urgent EGD patients with grade II B injury were given supplementary nutrition after previously inserted naso-jejunal tube under endoscopic control. In patients with grade III injury a feeding gastrostoma or jejunostoma was implanted within 96 hours after caustic ingestion in consultation with an abdominal surgeon. In the case of some patients where gastrostoma was inserted for decompression in the first 15 days, jejunostoma was also inserted for nutrition. Until insertion of nutritional sound or stoma patients were fed parenterally.

For each patient in the official record the following data were entered: anamnestic and heteroanamnestic information, gender and age, type and quantity of ingested caustic agent, time-frame from the moment of ingestion until the onset of symptoms and hospitalization. Besides standard laboratory examinations these parameters were also monitored: body weight, protein status (total proteins and albumins), transferrin, total lymphocyte count and nitrogen balance.

Body weight was controlled on admission, and every seven days during hospitalization and at the time of discharge. Measurement was done on mechanical scales in horizontal position. Total proteins and albumins were determined on admission and every ten days during hospitalization. Transferrin was determined every 10 days during hospitalization according to the following equation:

Transferrin = (0.8 x TIBC -43

In all of the patients nitrogen balance was determined according to the following standard equation:

Nitrogen balance = total number of protein and non-protein caloric intake for 24 hours: urine urea for 24 hours expressed in grams.

In giving supplemental nutrition to the patients liquids for enteral and parenteral nutrition that might be found on the market were used.

The statistical programme Statistika 7.1. was used for the statistical analysis. During that we evaluated the mean value, standard deviation ± 95 % Con.In, minimal and maximal value of the evaluated parameters, t-test for independent samples (t); so Fridman ANOVA test ($\chi 2$), Wicoxon matched pairs- test (Z);

3. RESULTS

The examined group of patients consisted of 33 patients, of whom 8 (22.24%) were males and 25 (75.76%) females. The age ranged in the interval 44.64±13.44 years, ±95.00 conf. int. 39.87-49.40; the youngest patient being 18 years old and the oldest 71 years. Of the total number of patients, the corrosive agent was ingested with suicidal intent by 29 patients (87.87%) and accidentally by 4 patients (12.12%).

Patients were hospitalized in the interval 29.52±5.91 days, ±95.00 conf. int. 27.42-31.61, minimum period of 19 days and maximum of 39 days. Majority of patients ingested HCl (n=21, 63.64%), followed by NaOH (n=9, 27.27%) and CH_3COOH (n=3, 9.09%). Days without oral food intake varied in the interval 13.33±2.30 days, ±95.00 conf. int. 12.52-14.15, minimum period of 8 days and maximum of 20 days.

Follow-up of our patients has revealed that there was a considerable body weight loss on day 7 (p<0.001), day

parametars	day	n	mean	Std.Dv.	t	p–finding
ABW			64.11	10.99		
BW	7	33	62.67	10.95	6.76	0.0000***
BMI	7		23.03	3.84	6.19	0.0000***
ABW			64.11	10.99		
BW	14	33	62.47	10.88	8.61	0.0000***
BMI	14		23.06	3.86	5.23	0.0000***
ABW			64.11	10.99		
BW	21	33	63.09	10.89	7.33	0.0000****
BMI	21		23.09	3.87	5.49	0.0000***
ABW			64.11	10.99		
BW	28	33	63.09	10.75	7.16	0.0000***
BMI	28					
BW	7		62.67	10.95		
BW	14	33	62.47	10.88	1.08	0.29
BMI	7/14		23.03/23.06	3.84/3.86	-0.57	0.57
BW	7		62.67	10.95		
BW	21	33	63.09	10.89	-2.18	0.04*
BMI	7/21		23.03/23.09	3.86/3.87	-0.81	0.42
BW	7		62.67	10.95		
BW	28	33	63.09	10.75	-2.51	0.02*
BMI	7/28		23.06/23.09	3.86/3.87	-0.44	0.66
BW	14		62.47	10.88		
BW	21	33	63.09	10.89	-4.46	0.0000***
BW	14		62.47	10.88		
BW	28	33	63.09	10.75	-4.35	0.0001***
BW	21		63.09	10.89		
BW	28	33	63.09	10.75	0.00	1.00

Table 1. Body weight/ differences. ABW – actual body weight, BW – body weight, p < 0.05* p < 0.001*** BMI – body mass index, p < 0.001***

14 (p<0.001), day 21 (p<0.001) and day 28 (p<0.001) as compared to the actual one on admission to hospital, which is explained with the severe post-corrosive situation and hypercatabolic state.

On the 21th day after admission, the body weight was significantly increased, for t=-2.18 and p<0.05.

On the 28th day after admission, the body weight was significantly increased compared to that on the 7th day, for t= -2.51 and p<0.05.

On the 21th day after admission to hospital the body weight was significantly increased compared to that on the 14th day, for t= -4.46 and p<0.01.

On the 28th day after admission the body weight was significantly increased compared to that on the 14th day, for t= -4.35 and p<0.01.

Body weight on day 21st and day 28th is the same, so there is no statistical significance, for p>0.05 (p=1.0).

Body mass index value on the 7th day(p<0.001),14th day(p<0.001), and 21st day(p<0.001), was significantly lower than the one on admission to hospital. In the other calculated relations there were no statistically significant changes (p>0.05). (Table 1).

Table 2 presents the differences in the values of total lymphocytes and transferrin within certain stages of the investigation.

Total lymphocyte count on the 10th day (Z=2.31 and p<0.05) and at the time of discharge (Z=3.56 and p<0.001) were significantly reduced in comparison with those on admission. Total lymphocyte count at discharge was insignificantly smaller than on the 10th day, for Z=1.33 and p>0.05.

Lymph /Trf	N	T	Z	p–finding
Lymph admiss./10 day	33	151.00	2.31	0.02*
Trf 10/20 day	33	161.00	1.93	0.054
Lymph admiss. / discharge	33	81.50	3.56	0.0004***
Trf 10 day / discharge	33	91.00	3.23	0.001**
Lymph 10 day / discharge	33	193.00	1.33	0.18
Trf 20 day / discharge	33	243.00	0.67	0.50

Table 2. Total number of lymphocytes/transferrin, p < 0.05* p < 0.001***, p < 0.01**, Lymph- total lymphocytes Trf- transferrin

Transferrin level on the 20th day was increased in comparison with the level on the 10th day, however, the increase was not significant for Z=1.93 and p>0.05. At discharge transferrin level was significantly higher in comparison with the level on the 10th day, for Z=3.23 and p<0.01. At discharge transferrin levels were higher than on the 20th day, however, the difference was not significant, for Z=0.67 and p>0.05. The results from the monitoring of total lymphocytes and transferrin level have shown that control of the nutritional status in caustic poisonings is very difficult and it is of huge importance for the final outcome of the poisoning.

Hypercatabolic condition and nitrogen imbalance are a common finding in critically ill patients, which was also the case with our patients. During the entire hospitalization there were variations regarding the levels of proteins and albumins that led to instability of the balance between the intake and loss of proteins.

Table 3 displays the differences in the levels of total proteins, albumins and nitrogen balance between certain stages of the examination. On day 10 total proteins had lower levels than on admission, however, the difference was not significant (Z=0,88 and p>0.005). At the time of discharge total proteins were elevated compared to those on admission, however the difference was not significant (Z=1.22 and p>0.05). At discharge total proteins were significantly elevated compared to those on admission (Z=2.69 and p<0.01).

On day 10 the level of albumins was substantially lower than on the day of admission (for t=2.22 and p<0.05). At discharge albumins had insignificantly lower level than on admission, however, this difference was not significant (Z=0.48 and p>0.05). At discharge the level of albumins were insignificantly elevated as compared with those on the 10th day (for Z=1.88 and p>0.05). The level of nitrogen balance was significantly reduced on the 10th day in comparison with the level on admission (for Z=2.48 and p<0.05). The level of nitrogen balance was reduced at discharge in comparison with the level on admission (for Z=1.74 and p<0.05), however, this difference was not significant. The level of nitrogen balance at discharge was insignificantly increased in comparison with the level on the 10th day (for Z=0.01 and p>0.05).

	N	T	Z		p–finding				
Period		Total proteins	Alb.	NB	Total proteins	Alb.	NB	Total proteins	Alb.	NB
Admiss./10 day	33	217.00	2.22	121.50	0.88	/	2.48	0.38	0.03*	0.01*
Admiss./Disch.	33	185.50	209.00	148.00	1.22	0.48	1.74	0.22	0.63	0.08
10 day/Disch.	33	129.50	175.50	217.00	2.69	1.88	0.01	0.007**	0.06	0.99

Table 3. differences in the levels of total proteins, albumins and nitrogen balance between certain stages of the examination, p < 0.01** p< 0.05*, p < 0.01 p > 0.05, Alb- albumins, NB- nitrogen balance

4. DISCUSSION

Incidence of acute caustic poisonings is increasing. In many studies it has been reported that they constitute 8-10% of the total number of poisonings, 18-80% of the complications and 4-38% of the mortality of the total number of patients (7, 8). Our data show incidence of 15-18% of the total number of poisonings, 14-27% of the complications, and 4-6% of the mortality (9).

The motive of poisoning can vary, which has been proved in our examination where there was a larger number of suicidal than accidental poisonings. Actually, this tendency is noticed in countries with the less developed health culture, lower level of education and social structures (10).

The primary reason for caustic poisonings in our patients was a suicidal intent (93.94%) against patients who unintentionally ingested a corrosive substance (6.06%). Contrary to our findings where prevailing patients were those who ingested the corrosive agent with suicidal intent, reports have been presented where the situation is quite opposite and the number of accidental poisonings was identical or even larger than the suicidal ones (11).

The most abused corrosive agents are acids (hydrochloric, acetic, sulphuric) and alkalis (NaOH), and rarely oxidans, phenols and their compounds. In our country the predominant poisonings are those with hydrochloric acid – HCl (n=21, 63.64%) in contrast with the European countries and USA where alkaline corrosive substances are more often ingested, especially those that contain hydroxide in concentration of 4% to 54% and are used as sanitary cleansing agents or detergents (12). Acids that are rarely abused in USA and Europe (<5%) are more frequently used in countries like Taiwan and the Balkan countries (>40%) (13).

Corrosive substances cause tissue destruction due to coagulation or liquefaction necrosis, which intensity depends on the type and concentration of the corrosive agent, duration of exposure, quantity of ingested agent, etc. Extensive injuries of the upper gastrointestinal tract hinder physiological nutrition in these patients and in no time they are in a severe general condition due to hypercatabolic state and negative nitrogen balance. Artificial nutrition is a life-maintaining therapy in patients who have inadequate food intake and who are at risk of malnutrition (14-15).

Our examinations have revealed body weight loss in the first 7-14 days after poisoning and on admission to hospital. However, after 7-14 days this decrease was not higher than 5% of the usual body weight, which is in line with the defined criteria. I consider it necessary to mention that baseline and actual energetic needs in our patients were calculated by previous determination of the ideal body weight since these patients were hospitalized in a good general health condition. Our results are based on the relation actual-ideal body weight, which is thought to be a bad indicator since rarely any patient prior to a disease has an ideal body weight. However, our patients were hospitalized and given artificial support without previous existence of evident disease that would lead to eventual disorder of weight and body mass index.

According to the criteria published in ESPEN in the third edition of Basics in Clinical Nutrition, 5% for 30 days is a mild loss in weight, 5-10% is a moderate loss and above 10% is a considerable weight loss (16, 17). A retrospective study on 30 patients with acute caustic injuries who were fed with combined enteral and parenteral nutrition showed that there was a weight loss in 15 patients (46.9%) during hospitalization for 6.6%, a negative nitrogen balance was found in 62.5% and the average albumin level was 32 g/l during hospitalization (18).

Although in our group of patients there was a considerable body weight loss in the relation actual – ideal body weight on the 7th and 14th day of hospitalization, actual body weight decrease was less than 10% on the 14th day indicating no malnutrition and a moderate loss of actual body weight was less than 5% indicating a mild body weight loss.

Serum transferrin participates in the iron metabolism and is a more sensitive indicator of protein-caloric malnutrition than albumin (due to the shorter half-life). Acute bleeding in the gastrointestinal tract in caustic poisonings and reduced iron levels that stimulate transferrin production often impede nutritional monitoring. Many studies have shown that serum transferrin, due to the short half-life (8.8 days), is a useful marker in nutritional assessment of critically-ill patients. Serum transferrin has a greater prognostic value and is more important indicator of nutritional deficits than other biochemical parameters (19). These literature reports are in agreement with the results obtained in our study.

European Society for Parenteral and Enteral Nutriton (ESPEN) emphasizes the importance of the total lymphocyte count in the evaluation of nutritional status in critically-ill patients who cannot be adequately fed by mouth. This parameter has an enormous significance in the nutritional support and control of immune system in patients. The total number of lymphocytes in our study was within the reference values (>900 cells/m^3) (20).

Nitrogen balance presents the difference between intake and elimination of nitrogen and it is an essential parameter in assessment of protein needs. Measurement of nitrogen excretion is a good indicator for evaluation of protein metabolism as well as of efficacy of protein utilization. Knowledge about nitrogen elimination is especially important in the treatment of critically-ill patients, who are under severe stress. Also, by optimizing the nutritional nitrogen dose, visceral and somatic metabolism might be influenced in these patients and hence, improvement of anabolism might be attained (21).

A double blind study of 12 patients has revealed that continual infusion with L-leucine and application of a special mixture of cysteine, threonine, serine and alanine contribute in maintenance of nitrogen balance in critically-ill patients. Caustic poisonings lead to severe degradation processes of the mucosa, submucosa and sometimes of the muscle layer of upper GIT. As a result of necrosis, there is an increased tissue degradation and consequently increased loss of proteins and nitrogen due to the potentiated catabolic processes in the organism. It is a known fact that there is a considerable nitrogen loss in stress situations (22).

Protein loss depends and is in direct proportional relation with caloric intake in the organism, which was also obvious in our patients where a large quantity of nitrogen and protein loss was observed at discharge from hospital when the intake of nitrogen and proteins was larger or close to the adequate proportions. The significant increase of nitrogen loss at discharge speaks in favor of stabilizing the protein intake and setting a balance of the metabolic and energetic processes in the patients.

Continual monitoring of plasma proteins is essential in follow-up of the nutritional status of patients since it is known that significant decrease of serum albumin levels increases morbidity, mortality and complications. Low levels of serum albumin is a sure sign of malnutrition, however, there are different opinions on which value of serum albumins is a good marker for malnutrition (23, 24).

A prospective study that comprised 8529 patients from

a large number of medical institutions in The Netherlands, who were on continual nutritional support, showed that 75% or 6396 patients were well-protein maintained and had no signs of malnutrition. Thirteen percent or 1108, in spite of the fair administration of nutritional liquids, were at risk of malnutrition whereas 12% or 1023 patients, in spite of fairly conducted parenteral and enteral nutrition were severely malnourished. Some authors point out that in the catabolic phase, in post-trauma patients, there is a substantial loss of nitrogen and proteins. For e.g., there is 30 grams per day in severe burns. Caloric intake might significantly influence on nitrogen and protein loss (25).

A number of authors state that no rapid changes of albumin levels are expected since they have a long half-life and a longer time is necessary for onset of changes. Every attempt of nutrition with albumin infusion is unjustified because each extensive infusion with albumin will not elevate the level of proteins in the circulation, but it will stimulate catabolism of the newly-synthesized albumin (26). In critically-ill patients complications are four-fold increased and mortality six-fold if the albumin level is under 35 g/l. Although it is a recognized fact that albumin is a sensitive marker for malnutrition, it has remained unclear whether its synthesis or loss has it influence in addition to inflammation and physical inactivity (27).

Our investigation has shown that nutritional therapy in acute caustic poisonings is of essential importance in the treatment, control of nutritional status, and biological and immunological balance. In 8 patients of our group (n =33) enteral nutrition was conducted at home until the moment when a surgical intervention was done in consultation with an abdominal surgeon.

5. CONCLUSIONS

Caustic poisonings are the most severe intoxications in clinical toxicology and are most frequently found in young adults full of life, who often end with a heavy invalidity and are a burden for the entire social community.

With artificial support we greatly succeeded in maintaining body weight, level of proteins and albumins, nutritional status and nitrogen balance in our patients.

We reduced the period of intensive care and the length of hospital stay by application of home enteral support in patients who developed stenosis of upper GIT within the course of treatment.

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