

Gastric Emptying Study by Scintigraphy in Patients with Chronic Renal Failure

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Summary: Hirata ES, Mesquita MA, Alves Filho G, Camargo EE – Gastric Emptying Study by Scintigraphy in Patients with Chronic Renal Failure.

Background and objectives: This study had the purpose of studying gastric emptying in patients with chronic renal failure.

Material and method: Thirty patients with chronic renal failure were studied, 16 in conservative clinical treatment and 14 in hemodialysis for over six months. The control group (CTL) was composed of 18 asymptomatic volunteers. The method of gastric emptying study was scintigraphy. The standardized test meal was an omelet of three chicken eggs prepared with colloidal sulfur marked with 185 MBq of 99 m technetium. Gastric retention curves were studied and T_{1/2} of gastric emptying was obtained from them. A T_{1/2} value corresponding to the average of T_{1/2} values of control group plus twice standard deviation was considered normal. Statistical tests used were χ^2 and Kruskal-Wallis.

Results: There was no statistically significant difference with regard to total gastric retention curves and T_{1/2} of gastric emptying, which was similar in three studied groups. Nine patients had high T_{1/2} of gastric emptying, above 125 minutes. These patients were equally distributed among both genders and conservative clinical treatment and hemodialysis groups.

Conclusions: We concluded that gastric retention rate and T_{1/2} of gastric emptying in patients with chronic renal failure in conservative clinical treatment and hemodialysis does not differ from the healthy patients group. Hemodialysis does not seem to reduce the risk of gastric retention in patients with chronic renal failure.

Keywords: Renal Insufficiency, Chronic; Gastric Emptying; Radiopharmaceuticals; Fasting; Renal Dialysis; Perioperative Care.

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INTRODUCTION

Difficulty of gastric emptying in patients with chronic renal failure was described for the first time by Goldstein, in 1967¹. The outcomes of the studies conducted after this date are controversial²⁻⁴. Among the possible reasons for these differences are a variety of methods used to study gastric emptying, lack of standardization of a test meal, different base renal diseases and type of treatment of patient, if by peritoneal dialysis, hemodialysis or conservative clinical treatment.

The possibility of delay in gastric emptying in chronic renal failure is attractive and there are many possible explanations for this dysfunction: metabolic acidosis⁵ and uremic neuropathy⁶, for instance, may interfere with emptying rhythm. This

alteration would also explain dyspeptic symptoms so common in these patients⁷.

In addition to that, gastric emptying has crucial importance in anesthesia, which can be summed up in one of its main aspects: preoperative fasting. A delay may cause gastric stasis, predisposing to vomit and aspiration risk⁸. The clinical importance may be extended if we think about the great focus it has been given to renal transplants in the last decades as the main way of treating renal failure. Special measures in anesthesia induction and recovery are recommended with the purpose of avoiding serious pulmonary complications that may occur in situations of gastric emptying disorders⁹.

This study has the objective of evaluating gastric emptying of a solid meal in patients with chronic renal failure in conservative clinical treatment or hemodialysis, using gastric scintigraphy.

MATERIAL AND METHODS

Patients

Thirty patients with chronic renal failure were studied. They presented creatinine clearance lower than 20 mL.min⁻¹ and were selected in the hemodialysis service and Uremia Ambulatory of *Hospital das Clínicas* of Unicamp (HC-Unicamp). Of these patients, 16 were in conservative clinical treatment and 14 in hemodialysis for over six months. Exclusion criteria for patients of conservative clinical treatment and hemodialysis

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group were the presence of *diabetes mellitus*, multiple myeloma, collagen diseases, peptic ulcer, gastric surgery and pregnancy. None of them was using medications that could affect gastrointestinal motility.

Control group

Control group was composed of 18 asymptomatic volunteers: Nine of them were male (average age: 35 ± 9 years) and nine female (average age: 41 ± 11 years), recruited among workers and doctors of HC-Unicamp. No patient was obese, had history of systemic disease, gastrointestinal disease, any previous surgery or was using medications that could affect gastrointestinal motility. No woman was in menopause, and all studies were carried out during first phase of menstrual cycle.

Test meal

The test meal consisted of an omelet made with three medium-sized chicken eggs, prepared with colloidal sulfur mix marked with 185 MBq of ^{99m}Tc . The omelet was cooked in the microwave for four minutes, until it acquired a firm consistency.

Gastric emptying study

The examinations were carried out according to the previously published technique^{10,11}. The participants were studied in the morning after a fasting period of ten hours, at least. The test meal was ingested in five minutes and it was followed by the ingestion of 25 mL of water. Immediately after ingestion, the individual was positioned sitting down between two heads of scintigraphy chamber to acquire images in anterior and posterior projections of epigastric region that was placed within field of view of both heads.

Static images of stomach were acquired in anterior and posterior incidences simultaneously. From time zero, immediately after ingesting the meal, and at every ten minutes, a 60 second lasting image was obtained until 120 minutes were completed, totalizing 26 images (13 in anterior and 13 in pos-

terior position). The images were processed through SOPHY NXT program of Nuclear Medicine Service. Initially, we determined 26 regions of study interest in anterior and posterior projections. After correction for radioactive decay, the geometric mean of radioactive counts of anterior and posterior regions were determined. Thirteen values of geometric mean were obtained, regulated by the highest value in a scale from zero to one. With those data, charts of total gastric retention were plotted having time in minutes in the x axis and the radioactive count in the y axis. From the gastric retention curve the $T_{1/2}$ of total gastric emptying was calculated, time required for stomach to empty 50% of standardized test meal.

Statistical analysis

The outcomes are presented as average \pm SD. Statistical treatment was included in χ^2 test to compare qualitative variables, of Mann-Whitney test to compare two numeric variables and Kruskal-Wallis test to compare three or more groups of numerical information of independent samples. The p-values < 0.05 were considered statistically significant.

For individual analysis of outcomes, the upper limit of normality for $T_{1/2}$ values, the average of $T_{1/2}$ values of control group plus twice standard deviation was considered.

Ethic aspects

This study was approved by Ethics Committee in Research of *Faculdade de Ciências Médicas* of Unicamp, considering that the use of a meal aggregated to a radioactive drug to study gastric emptying is supported by data of international literature. At the same time, confidentiality of information and the use of obtained outcomes solely for scientific purposes were ensured. The informed consent term was signed in the interview, when the patient was invited to participate in the research after clarifications about the study.

RESULTS

Analysis of data confirmed the homogeneity of groups for age and gender (Table I).

Table I – Distribution by Gender and Average Age, Standard Deviation, Minimum and Maximum Value (Min-Max) in Years in Conservative Clinical Treatment, Hemodialysis Groups and Control Group

	Conservative CT Group	Hemodialysis Group	Control Group
*Age (A \pm SD) years	39.8 ± 14.1	42.5 ± 11.2	36.6 ± 10.6
Min-Max	18-60	18-60	24-55
**Gender M / F	9 / 7	6 / 8	9 / 8

*Kruskal-Wallis: $p = 0.353$; ** χ^2 : $p = 0.751$; A: Average; SD: Standard Deviation; CT: Clinical Treatment.

Creatinine clearance and time of hemodialysis treatment were within values previously defined in the study: 14.3 (± 4.4) mL.min⁻¹ and 32.9 (± 40.2) months, respectively.

In Figure 1 total gastric retention curves in conservative clinical treatment, hemodialysis and control-group groups are represented. There was no statistically significant difference between groups in any studied times.

T_{1/2} values of gastric emptying can be seen on Table II. There was no statistically significant difference between T_{1/2} values in three studied groups. However, in individual analysis,

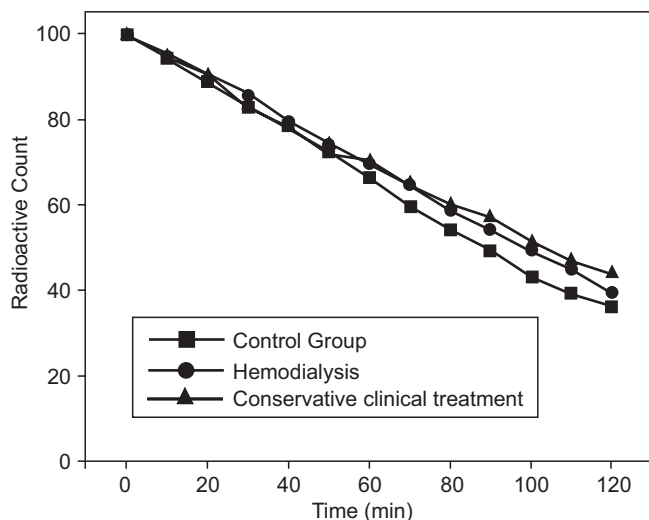


Figure 1 – Total Gastric Retention Curves, Calculated with Averages of Values of Percentages of Radioactive Counts *versus* Time, in patients with Chronic Renal Failure in conservative clinical treatment, hemodialysis and healthy individuals.

we identified nine patients (30%) that had delay in gastric emptying, namely, T_{1/2} over 125 minutes.

On Table III, it can be observed that five of them were male and four female. The proportion of patients with slow gastric emptying in conservative clinical treatment and hemodialysis groups was also similar.

DISCUSSION

Our results demonstrated that total gastric retention curves and T_{1/2} values of gastric emptying in patients with chronic renal failure in conservative clinical treatment or hemodialysis did not statistically differ from outcomes observed in control-group individuals, without signals or symptoms of gastrointestinal disease and/or renal dysfunction. However, in individual analysis, we identified nine patients (30%) with slow gastric emptying, equally distributed among conservative clinical treatment and hemodialysis groups.

Since the first registration of delayed gastric emptying in uremic patients, it is observed that publications on the subject are usually with small casuistics and contradictory outcomes²⁻⁶. In clinical studies there is a lack of standardization not only in the methodology employed in gastric emptying study, but also in the classification of renal dysfunction degree and type of treatment the patient undergoes. There are few references on exclusion of gastric diseases and concomitant systemic ones. Those variables would already be enough to justify paradoxical outcomes found in studies that try to correlate uremia with difficulties in gastric emptying.

In our study we tried to define the variables that could influence gastric emptying measurement. The adopted normality standard was obtained from a test meal studied in a group

Table II – Values of Average, Standard Deviation, Minimum and Maximum T_{1/2} of Gastric Emptying in Patients of Conservative Clinical Treatment, Hemodialysis Groups and Control Group

	Conservative CT Group	Hemodialysis Group	Control Group
T _{1/2} (Average ± SD) min	109.7 ± 38.0	102.9 ± 31.2	87.2 ± 18.9
Min-Max	56.4 –194.0	64.7 –172.7	67.3 –132.7
N	16	14	17

Kruskal-Wallis: p = 0.176; CT: Clinical Treatment.

Table III – Distribution of Patients with Slow Gastric Emptying According to Gender and Type of Clinical Treatment, Conservative or Hemodialysis

	T _{1/2} > 125 min		T _{1/2} < 125 min	
	N	%	N	%
*Gender				
Male	05	55.56	10	47.62
Female	04	44.44	11	52.38
Total	09	100.00	21	100.00
*CRF Treatment				
Conservative CT Group	05	55.56	11	52.38
Hemodialysis Group	04	44.44	10	47.62
Total	09	100.00	21	100.0

*Fisher: p = 1.000; CRF: Chronic Renal Failure; CT: Clinical Treatment.

of healthy individuals of both genders. In the group formed by patients, we tried to control the variables already mentioned in the literature. Although there are controversies, it seems gastric emptying is slower in women than men^{11,12}, because feminine sexual hormones have an inhibitor role in gastric motility¹³. With menopause, this effect disappears and gastric emptying rates in both genders tend to be the same¹⁴. There are few studies on effect of age on gastric emptying and outcomes are contradictory. In a population of Chinese individuals, it was already observed that gastric emptying for liquids was impaired in individuals above 60 years old¹⁵. It was defined in our study that age must be within 18 and 60 years and it was paid attention that gender distribution was similar in the three groups.

Diabetes mellitus and other diseases like multiple myeloma and some collagen diseases may run through delayed gastric emptying. Diabetic gastroparesis is a complication associated with long-lasting insulin-dependent diabetes, with autonomic dysfunction and peripheral neuropathy. In general, emptying of solids and liquids is impaired^{16,17}. In case of collagen diseases, the ones more often associated with gastric emptying alterations are progressive systemic sclerosis and systemic lupus erythematosus¹⁸. We chose to exclude patients who have such diseases. The choice of gastric scintigraphy for our study is supported by literature: it is considered the best method of gastric emptying study^{19,20}. Other employed methods are paracetamol, ultrasonography and retention of radiopaque markers^{3,4,21}. Most studies use T_{1/2} and gastric retention curve as main parameters.

For the study a group of pre-dialysis chronic renal patients and another group already in dialysis for at least six months were selected. According to literature data, gastrointestinal anatomic alterations are less frequent in uremic patients in dialysis as well as some dyspeptic symptoms like nausea and vomit²¹, suggesting that dialysis would reduce the occurrence of some uremia signals and/or symptoms. Thus, if the emptying delay observed in some studies were related to uremia or any uremic factor, it would be plausible to expect it would be more frequent in patients who are not in dialysis treatment

yet. We could not confirm this assumption in our study because in all points of curve, including T_{1/2}, there was no difference between three studied groups. This hypothesis was recently investigated in two other studies, which had discordant results. Schoenmakere et al.²² identified slow gastric emptying in patients in hemodialysis, whilst Adachi et al.²³ suggest that hemodialysis treatment result in improvement of gastric motility and reduction of gastrointestinal symptoms.

Again, differences in employed methodology could explain these contradictions. In Schoenmakere's study, patients were older, above 60 years old, were in dialysis treatment for over 3.5 years and received a test meal different from the one used in our study. In Adashi's study, in addition to different method of gastric emptying study, the employed test meal was semi-solid.

Our findings on the existing percentage of uremic patients with delayed gastric emptying are in agreement with other studies²⁴. In our study, we found nine patients (30%) who had T_{1/2} value above the average of the control group, twice the standard deviation. Analyzing these patients, we observed that they are equally distributed in conservative clinical treatment and hemodialysis groups and there was no association with gender. These patients tend to increase T_{1/2} average of group, but not enough to be statistically significant. It is possible that a more detailed study of gastric motility, like proximal and distal distribution of food, may be elucidative to identify among uremics and not in uremia any risk factor that predisposes to delayed gastric emptying.

CONCLUSION

Gastric emptying study in patients with chronic renal failure in both dialysis and conservative treatment did not show statistically significant differences in gastric retention curve and in T_{1/2} of gastric emptying, when compared with a group of health individuals.

Hemodialysis does not seem to reduce the risk of gastric retention in patients with chronic renal failure.

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