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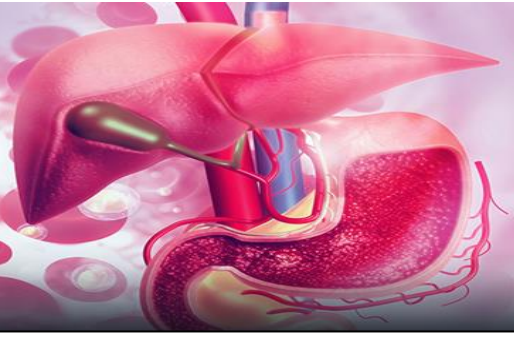

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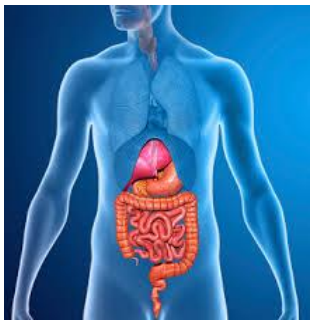
A machine learning-based approach for the early prediction of gallstone disease using bioimpedance and laboratory data

INTRODUCTION



Digestive tract disease

Gallstones, which come in various sizes, are solid aggregates that can develop in the biliary tree in places like the gallbladder (cholecystolithiasis) and the bile ducts (choledocolithiasis). Gallstones are more common in women than in men and become more common with age. Cholelithiasis has an annual incidence rate of 0.60–1.39%, according to research on the natural history of the illness. With a prevalence of over 20% in adults in advanced countries, gallstone disease is one of the most common digestive illnesses.[1] Transabdominal ultrasonography, which has an 84% sensitivity and 99% specificity, is still the method of choice for gallstone detection. But in some cases, especially with stones smaller than 3 mm, its effectiveness may be compromised. Bioimpedance Analysis (BIA) is a widely used non-invasive and affordable technique for measuring body composition, including total body water, lean mass, and fat mass. Gallstones can also be successfully detected using it. While conventional diagnostic methods like CT, MRI, and ultrasonography can identify gallstones, they have some drawbacks, such as high expense and possible inaccuracy in specific patient populations. This study uses laboratory data and bioimpedance to develop a machine learning-based gallstone disease prediction model.[2]

METHODS

This was a prospective descriptive study. A total of 319 participants were enrolled. Of these, 158 were considered to be healthy controls, while 161 had gallstones. Gallstone status, age, sex, comorbidities, hypertension, hypothyroidism, lean mass, protein content in the body, visceral adiposity index, bone mass, hyperlipidemia, diabetes mellitus, height, weight, body mass index (BMI), total body water (TBW), extracellular water (ECW), intracellular water, muscle mass, degree of obesity, total fat content, visceral fat area, visceral muscle area, hepatic fat accumulation, glucose levels, total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL) cholesterol, triglycerides, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), creatinine, glomerular filtration rate (GFR), C-reactive protein (CRP), hemoglobin (HGB), and vitamin D concentration were among the 38 features covered by the dataset. Ultrasonography revealed the presence of hepatic fat build up (fatty liver stage). Using blood tests, the following characteristics were measured: creatinine (mg/dL), GFR (ml/seconds), HGB (g/dL), CRP level (mg/L), AST (U/L), ALT (U/L), ALP (U/L), glucose levels (mg/dL), TC (mg/dL), LDL cholesterol (mg/dL), HDL (mg/dL), triglycerides (mg/dL), and vitamin D concentration (ng/mL) were detected in the blood tests. Based on bioimpedance and laboratory data, the study employed k-nearest neighbors, multilayer perceptron, support vector machines, decision tree, random forest, adaptive boosting, gradient boosting, naïve Bayes, and logistic regression techniques to predict whether a person had a gallstone.

RESULTS

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The current study showed that vitamin D had the highest F-score (23.42) and may be a significant factor in gallstone prediction. Significant information for gallstone prediction was also provided by the notable scores of 15.0 and 12.96 for CRP and total body water, respectively. The ability to identify gallstones depends critically on lean mass, bone mass, and total body fat ratio. Figure 1 illustrated the nine key characteristics that were shown to be important for gallstone prediction. HGB, HDL, BMI, height, and diabetes had minimal effects on gallstone detection, but still played a substantial part in the prediction process. Sex has moderate significance in detecting gallstones. Gallstone prediction differs between sexes. Gallstone identification was not significantly affected by ALT, age, HGB, GFR, visceral adiposity index, TC, or glucose levels. The gradient boosting technique achieved the highest accuracy (85.42%) in predicting gallstones, with vitamin D, total body water, lean mass, and C-reactive protein (CRP) level being critical factors. For the early detection of gallstone disease, the suggested method provides a strong substitute for conventional imaging methods.

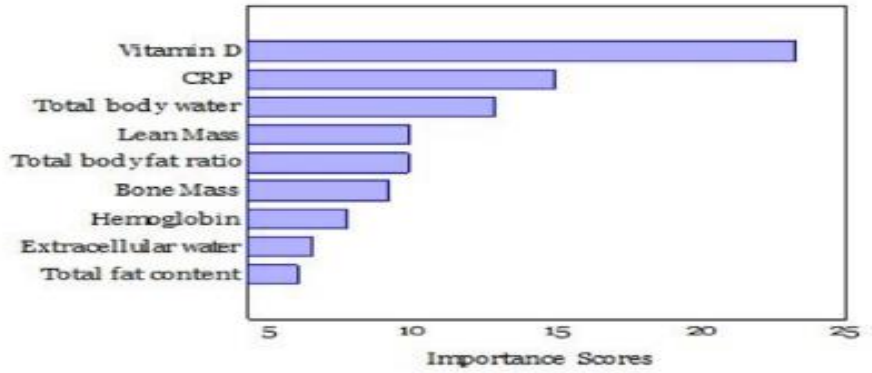

Figure 1. Calculation of significance scores by F-score using ANOVA. CRP = C-reactive protein.

DISCUSSION

The current study showed that the gradient boosting technique accurately predicted gallstones with 85.42% accuracy, taking into account significant factors such as vitamin D level, CRP level, total body water, and fat-free mass.[2] Shabanzadeh et al. found a positive correlation between CRP levels and gallstones.[3] According to Liu et al., high CRP levels were an independent risk factor for developing gallstones.[4]

CONCLUSION

This study demonstrated the significance of data in the detection of gallstones through analysis utilizing nine distinct machine learning techniques, including bioimpedance and laboratory features. This indicated the existence of gallstones and gives medical experts and clinicians a way to potentially diagnose and treat patients early on based on these markers. Comparable to abdominal ultrasonography, bioimpedance and laboratory evaluations have a lot of potential and can be utilized for illness prediction.

Comparable to abdominal ultrasonography, bioimpedance and laboratory evaluations have a lot of potential and can be utilized for illness prediction.

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Evaluation of possible risk factors for postoperative complications and disease recurrence specifically after colonic resections for Crohn's disease

INTRODUCTION

A chronic, granulomatous, inflammatory bowel disease that can impact the entire gastrointestinal tract and extraintestinal organs is called Crohn's disease (CD). Transmural, penetrating diseases of the colon or terminal ileum are usually seen in patients. In Western nations, Crohn's disease has the highest rates of incidence and prevalence, peaking in adolescence and early adulthood.[1] A significant number of patients with CD will eventually require surgery, even with a conservative therapy approach that includes steroids, disease-modifying anti-rheumatic drugs (DMARDs), or monoclonal antibodies (MAB) as the first line of treatment. The underlying inflammation and high rates of morbidity and illness recurrence, however, make surgical techniques difficult. More and more genetic variations associated with an aggressive phenotype have recently been found, which has advanced treatment choices and reduced the need for surgery. However, surgery was frequently unavoidable. The purpose of the study was to assess potential risk factors, particularly following colonic resections for CD, for both postoperative complications and disease recurrence.[2]

METHODS

This was a monocentric, observational cohort study and included 241 individuals who had ileocaecal and colonic resections for CD. The clinical documentation system, clinical charts, endoscopic reports, anesthesiology reports, and genetic alterations were used to extract demographic information, medical history, clinical examination results, pre- and postoperative medication therapy, length and type of surgery, and postoperative complications data. The main outcomes were determined to be overall perioperative morbidity and death. Secondary outcomes were the association between morbidity and prior medical therapy, length of disease, prior surgeries, timing of surgery, diagnosis leading to surgery, type of surgery, underlying genetic mutation, and rate of disease recurrence. The SPSS statistical software package (version 27.0, IBM, Chicago, IL) was utilized for statistical analysis. For comparative analysis, the chi-square test or Mann-Whitney U test was employed.

RESULTS

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The current study result showed that in 23.8% of cases, there were major problems. The population's overall mortality rate was 1.25 percent (n=3). Compared to patients after ICR, patients following colonic resections had a considerably greater rate of serious postoperative problems (p <0.0001). Postoperative bleeding (22.2%), the necessity for revision surgery (27.3%), and ICU or hospital readmission (15%) were the most frequent complications following colonic resections. There was no difference between the groups in terms of anastomotic leaks, abdominal fluid collections, wound infections, or the need for vacuum therapy (Figure 1). The time between admission and surgery (p=0.015) and the length of the procedure (p=0.001) were found to be risk factors for the latter. Nevertheless, no significant relationship was found between postoperative morbidity following colonic resections and gender, age, or prior medical problems, neither before nor after surgery. A higher incidence of revision surgery and a subsequent stoma was associated with isolated distal resections (p=0.019). Simultaneously, the risk of postoperative ICU admission was elevated by distal resections (p=0.0019), the time gap between hospital admission and surgery (p= 0.001), and prior bowel resections (p < 0.0001). Additionally, distal resections were found to be a significant risk factor for bleeding after surgery (p < 0.0001). Previous bowel resections were found to be an independent risk factor for significant perioperative complications (p=0.037) in the entire study population.

	Colonic resection, *n* (%)	ICR, *n* (%)	*p* value
Postoperative bleeding	30 (22.2)	2 (1.9)	**<0.001***
Anastomotic bleeding	2	2	
Intrabdominal bleeding	2	0	
Source not documented	26	0	
Woundinfection	28 (20.9)	13 (12.5)	0.890
Vacuum therapy	18 (13.4)	3 (2.9)	0.040
Intraabdominal fluid collection	22 (16.4)	7 (6.7)	0.023
Anastomotic leak	7 (5.2)	6 (5.7)	0.857
Subileus	4 (3.0)	6 (5.8)	0.283
Ileus	4 (3.0)	0 (0.0)	0.073
Re-do procedure	37 (27.4)	7 (6.8)	**<0.001***
Readmission to ICU	23 (17.2)	2 (1.9)	**<0.001***
Readmission to hospital	20 (15.0)	4 (3.9)	**<0.001***
Overal rate of major complications	47 (34.6)	10 (9.4)	**<0.001***

Figure 1. Postoperative complications distribution

DISCUSSION

The current study showed that duration of surgery and the interval between hospital admission and operation were found to be two independent risk factors for significant morbidity after colonic resections.[2] These results were consistent with those obtained by Kanazawa et al. The incidence of postoperative intra-abdominal septic complications in CD was considerably enhanced by handsewn anastomoses, penetrating type, and operation

times longer than 180 minutes. The short-term result for CD patients was negatively impacted by postoperative intra-abdominal septic complications.[3]

CONCLUSION

The current study concluded that colonic resections for CD represent a difficult surgical situation. A severe phenotype when combined with a sophisticated surgical operation was a meaningful risk factor for a problematic perioperative course, as evidenced by greater rates of morbidity following colonic resections compared to ICR and higher rates of problems following distal resections. Longer ICU stays were linked to greater recurrence rates, suggesting that this tendency may be exacerbated by a potential delay in receiving preventative medical care.

A severe phenotype when combined with a sophisticated surgical operation is a meaningful risk factor for a problematic perioperative course, as evidenced by greater rates of morbidity following colonic resections compared to ICR and higher rates of problems following distal resections.

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Identification of prognostic factors for patients with acute lower gastrointestinal bleeding and development of a high-accuracy prediction tool

INTRODUCTION

Acute lower gastrointestinal bleeding (ALGIB) is defined as blood loss with a recent beginning from the colon. Acute lower GI bleeding can be classified into four types: anatomic (diverticulosis), vascular (angiodysplasia, ischemic, radiation-induced), inflammatory (infectious, inflammatory bowel disease), and neoplastic. Furthermore, acute lower GI bleeding can occur following therapeutic procedures such as polypectomy.[1] Previous studies on the risk of long-term mortality (≥1 year) after hospitalization for ALGIB have been limited to a few single-centre studies with small sample sizes (n<500). Variables such as vital signs, general condition, comorbidities, and in-hospital management have not been evaluated. In addition, close monitoring of high-risk ALGIB patients was necessary, but there was currently no proven predictive scoring method that classifies long-term mortality risk and identifies high-risk individuals. In addition to creating a high-accuracy prediction tool, the study aimed to determine prognostic markers for individuals with ALGIB.[2]

METHODS

This was an observational, multicenter, retrospective investigation. It comprised 8254 acute hemolytic patients who needed to be admitted right away after presenting in an outpatient setting. Using a random number table, patients were randomized in a 2:1 ratio to a derivation cohort (n = 5459) and a validation cohort (n = 2795). Because the major objective of this study was to accurately predict death using clinical signs at the time of onset, the investigation was performed on patients with acute hematochezia, including AUIGB, rather than ALGIB. Information was gathered from electronic endoscopic databases and patient files. Baseline parameters, such as performance status (PS), vital signs, symptoms, initial laboratory results, medications, and comorbidities, were gathered in addition to in-hospital care data. To determine the Charlson Comorbidity Index (CCI), comorbidities were gathered. The characteristics that were present at the time of admission were used to predict mortality within 30 days of hospitalization, with the underlying premise being that these factors were highly correlated with death. In-hospital management factors were added to the admission factors to predict mortality within a year of hospitalization, as it was hypothesized that these factors also contributed to death. The main result was mortality within a year after admission, which was characterized as any kind of death that occurred between the time of admission one month later to the day of admission 365 days later. Mortality within 30 days of admission, defined as anyone who passed away within 30 days of admission for any cause, including hospital stays, was the secondary outcome. For 30-day mortality, the logistic regression model was used to determine the crude odds ratios (ORs), adjusted ORs, and 95% confidence intervals (CIs). The Cox proportional hazards model was employed in the univariate analysis to evaluate the factors associated with 1-year mortality.

RESULTS

The current study results showed that 51 (0.9%) of the 5459 patients passed away within 30 days in the derivation cohort, with 7 (0.1%) of those deaths being due to bleeding. 26 baseline indicators were shown to be associated with 30-day mortality by univariate analysis. Six characteristics were found to be risk factors for 30-day death by multivariate logistic regression analysis: cirrhosis, blood urea nitrogen (BUN) ≥25 mg/dL, C-reactive protein (CRP) ≥1.0 mg/dL, albumin level <3.0 g/dL, performance status (PS) ≥2, and concomitant metastatic cancer. The new score's ROC-AUC for the derivation cohort was 0.92 (95% CI 0.88–0.96), which was far higher than the clinical risk scores that were already in place (ROC-AUC: Sengupta, 0.89; NOBLADS, 0.84; CCI, 0.78; Oakland, 0.71). The low-, medium-, and high-score groups had 30-day mortality rates of 0.1% (n = 5), 2.3% (n = 23), and 18.2% (n = 24). The new score's ROC-AUC in the validation cohort was 0.90 (95% CI 0.85–0.95). The 30-day death rates for patients in the low-, medium-, and high-score groups were 0.2% (n = 4), 1.2% (n = 6), and 20.6% (n = 13), respectively. When comparing the low- and medium-score groups to the high-score group, the death rates were considerably higher in the medium-score group (low vs. medium score, P=0.003; high vs. medium/low scores, P<0.001).

Out of 4030 patients in the derivation cohort, 163 (3.0%) passed away in less than a year. According to univariate analysis, 34 variables from the baseline characteristics and in-hospital management data were related to 1-year mortality. The c-statistic for the unique score in the derivation cohort was 0.87 (95% CI 0.84–0.90). According to Figure 1, a log-rank test showed that patients in the high-score group had considerably higher odds of dying than patients in the low-score group (HR 84.20; 95% CI 52.6–137.9; P < 0.001) and the medium-score group (HR 14.25; 95% CI 9.32–21.8; P < 0.001). The groups with low, medium, and high scores had 1-year mortality

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rates of 1.0%, 13.4%, and 54.3%, respectively. In the validation cohort, the c-statistic for unique scores was 0.84 (95% CI 0.80–0.89). The probability of mortality was considerably higher in the high-score group (HR 33.10; 95% CI 15.8–69.4; P<0.001) and intermediate-score group (HR 9.25; 95% CI 5.6–15.3; P<0.001) than in the low-score group. The 1-year mortality rates were 1.6%, 14.4%, and 38.5% for the low-, medium-, and high-score groups, respectively (low vs. high and low vs. intermediate: P<0.001; intermediate vs. high: P=0.012). To find out how different factors—which were divided into three categories—associated with 1-year mortality, group analysis was performed. A decrease in albumin levels (< 2.5, 2.5–2.9, and ≥3.0 g/dL) and BMI (<17.0, 17.0–18.4, and ≥18.5) increased the chance of 1-year death (all: P < 0.001) in the Cox proportional hazards model. On the other hand, the risk of 1-year death (all: P<0.001) was significantly enhanced by increases in PS (1, 2, 3, and 4), BUN (< 25.0, 25.0–29.9, > 30.0 mg/dL), CRP (< 1.0, 1.0–2.9, and > 3.0 mg/dL), and the amount of blood transfusion (none, 1–7 units, and 8 units).

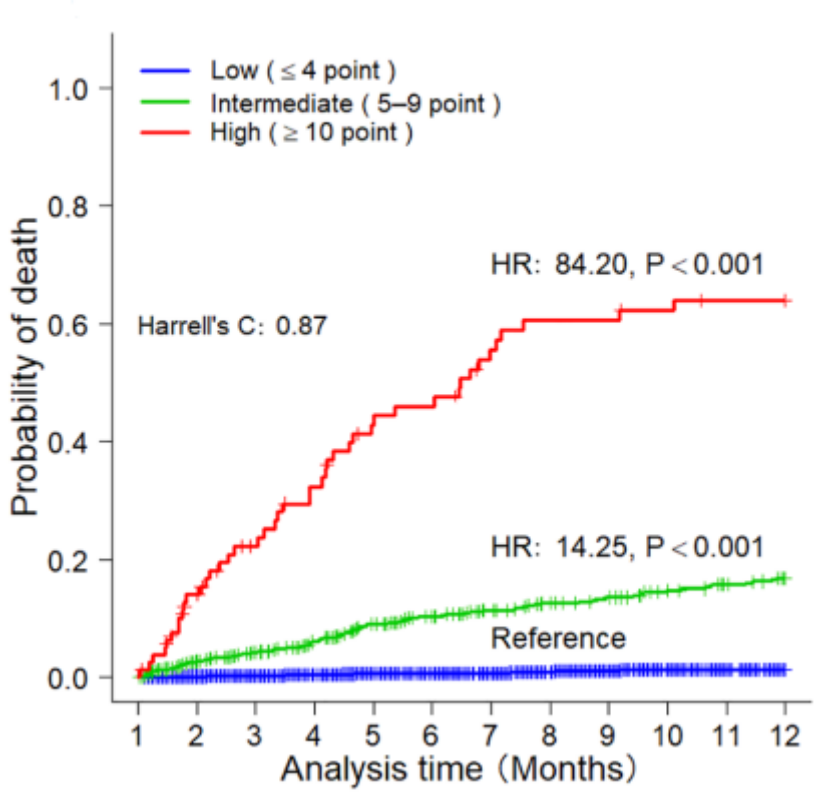

Figure 1. The derivation cohort's cumulative probability of mortality by risk category

DISCUSSION

The current study showed that 30-day and 1-year mortality rates were quite low, at 0.9% and 3.0%, respectively. The study developed the CACHEXIA score, a very accurate (c-index 0.87) long-term prognostic scoring system that accounts for the following: Albumin, Cirrhosis, High PS, Extremely thin (i.e., low BMI), Increased CRP and

BUN, Anaemia (i.e., blood transfusion), Cancer includes metastatic tumour, blood tumour, and bleeding from tumour).[2] Comparable to the current study's 3.0% death rate, Aoki et al. (n = 342) and Arroja et al. (n = 364) reported long-term prognostic mortality rates of 2.2% and 4.2%, respectively, one year after hospitalisation.[3,4]

CONCLUSION

The current study concluded that the prognosis of patients with acute hematochezia was not as strongly correlated with bleeding severity, diagnosis, or therapy, but rather with chronic disorders and concomitant cachexia. Based on this unique predictive score, high-risk patients should be monitored in the medical facility even after being discharged from ALGIB hospitalization, even though the overall death rate was low.

The prognosis of patients with acute hematochezia is not as strongly correlated with bleeding severity, diagnosis, or therapy, but rather with chronic disorders and concomitant cachexia.

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Case report on Gastroduodenal Involvement in AL Amyloidosis

INTRODUCTION

Amyloidosis is a disease that causes aberrant protein deposits to form outside of cells in different organs. There are six different forms of amyloidosis: primary, secondary, hemodialysis-related, hereditary, senile, and localized. Tissue and organ function are disrupted as a result of these proteins' aberrant folding and deposition as insoluble fibrils. Amyloidosis typically manifests as systemic involvement, with the gastrointestinal tract being affected in 50–70% of patients.[1] The most common form of amyloidosis was systemic AL amyloidosis, also known as primary amyloidosis, which was caused by the deposition of immunoglobulin light chains produced by clonal plasma cells into organ systems throughout the body. Amyloid deposits in the GI system can cause varying symptoms according to their location. The symptoms of the gastrointestinal tract can vary from dyspepsia or pain

in the abdomen to more severe issues like bleeding in the gastrointestinal tract, malabsorption, dysmotility, and obstruction. This case report aimed to present a case of epigastric pain and inadvertent weight loss in a patient with a documented history of IgG lambda AL amyloidosis. After undergoing esophagogastroduodenoscopy (EGD), the patient's gastroduodenal amyloidosis was identified.[2]

CASE PRESENTATION

A 66-year-old female patient had hypertension, hyperlipidemia, AL amyloidosis, and chronic kidney disease. Based on findings from bone marrow biopsies (lambda-restricted CD138-positive cells), renal (scattered foci of randomly arranged fibrillary material in the glomerular mesangium and glomerular capillary walls and positive Congo red stain compatible with amyloid), and serum protein electrophoresis (IgG lambda spike), the patient was diagnosed with AL amyloidosis. She attended for assessment due to bloating, inadvertent weight loss of ten pounds, and discomfort in the epigastric area. She denied experiencing dysphagia, odynophagia, altered bowel habits, nausea, vomiting, melena, or hematochezia. One year before her presentation, she had a colonoscopy, and the results showed that she was normal with few little hemorrhoids. EGD was carried out because of the patient's history of unintended weight loss and epigastric discomfort. The patient showed mild gastropathy, with a 6 mm sub-epithelial nodular lesion in the gastric body and a fine granular appearance in the second half of the duodenum. During the EGD, the whole esophagus and duodenal bulb were normal. The stomach and duodenum biopsies showed a strong Congo red stain, which was consistent with amyloid build-up (Figure 1). The biopsy results indicated gastroduodenal amyloidosis as the most likely cause of her symptoms. The patient was on cyclophosphamide, bortezomib, and dexamethasone (CyBorD) and has started hemodialysis due to renal disease progression. The patient has been advised to visit the outpatient clinic for regular symptom monitoring.

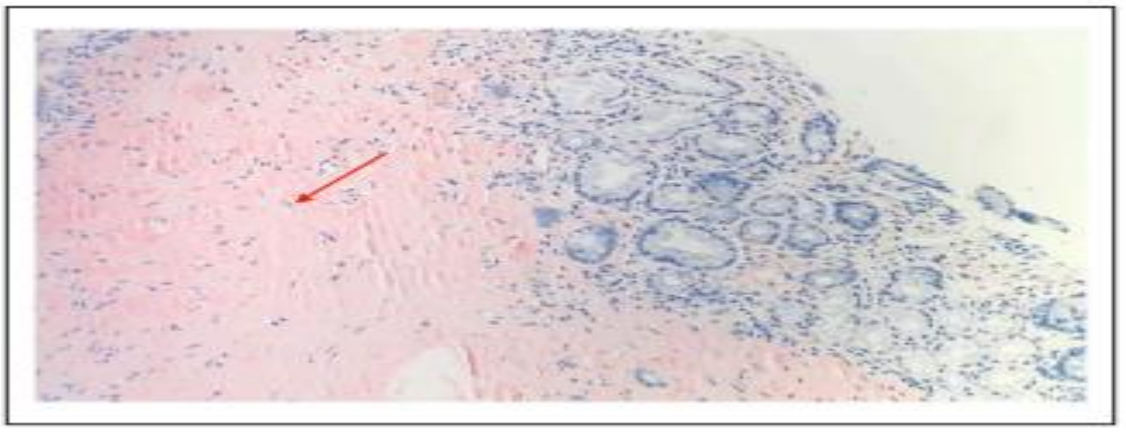

Figure 1. Duodenal biopsies—positive Congo red stain (red arrow)

DISCUSSION

The current case report showed that a case of epigastric pain and inadvertent weight loss in a patient with a documented history of IgG lambda AL amyloidosis. After undergoing esophagogastroduodenoscopy (EGD), the patient's gastroduodenal amyloidosis was identified.[2] Similar to this case report, Almushait YB et al. showed that

a 36-year-old male patient with many comorbidities who came with right upper quadrant abdominal pain was found to have gastroduodenal amyloidosis.[1]

CONCLUSION

This study concluded that clinical symptoms of gastrointestinal amyloidosis might vary greatly depending on the extent and site of infiltration. In the context of established AL amyloidosis, it was crucial to take into account, GI amyloidosis as a potential explanation for unexplained gastrointestinal symptoms because diagnosis was frequently delayed in these patients. The goal of management should be to address both the underlying cause of amyloidosis and its symptoms.

Diagnosis was sometimes delayed in these patients, hence it was critical to explore GI amyloidosis as a possible cause for unexplained gastrointestinal symptoms in the presence of established AL amyloidosis.

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