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Relevance of Barium Studies in an Era of Cross-Sectional Imaging in a Low Resource Economy

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Abstract

Purpose: The demand for barium tests has steadily decreased since the development of contemporary imaging technology, for a variety of reasons, in the current era of cancer. It is crucial to note right now that barium exams will never be unnecessary. Barium exams have largely been superseded by a number of advanced imaging modalities in recent years, including high resolution ultrasonography, endoscopy, colonoscopy, computed tomography (CT scan), magnetic resonance imaging (MRI), and defecography. Barium swallows still outperform endoscopy, manometry, and 24-hour esophageal pH monitoring in the assessment of motility issues, sub-mucosal lesions, and extrinsic pathology even though these diagnostic techniques are equally helpful in the evaluation of esophageal illnesses. The target is to maintain the traditional barium study method for the patient's benefit and proper care, as well as to keep it alive. The objective is to safeguard barium radiology for the high standard of patient care rather than to "save" barium exams only to maintain this technology. The main aim of this study is to review the various forms of barium studies

Methodology: Relevant databases such as PubMed, Google Scholar and Embase to search for literature related to barium studies and cross sectional imaging were used for this study. Search strategy including keywords related to barium studies, cross-sectional imaging and low resource economies. This may include terms such as barium swallow, barium meal, computed tomography, magnetic resonance imaging.

Findings: Conventional Barium examinations still have a purpose in determining the state of the mucosa, diameter of the lumen, degree, and type of obstruction even though CT and MRI have essentially superseded them. Additionally, barium offers live data on intestinal transit duration and motility. On a CT scan, these characteristics are not visible

Recommendations: To prevent this modality from going extinct and ultimately harming patients, teaching institutions should encourage radiologists to become conversant with Barium studies.

Keywords: *Barium, Ultrasonography, Computed Tomography, Endoscopy*

1.0 INTRODUCTION

Historically, the first use of X-rays in medicine was for the examination of gastrointestinal diseases using barium as a positive radiographic contrast medium. It served as the cornerstone and the primary diagnostic technique to look at gastrointestinal diseases [1]. Accurate anatomical representation was made possible by a number of modifications to the composition of barium and its procedures (high density, double contrast). Image intensification, automatic exposure, automatic film processor systems, and other technological advancements made it easier to complete these laborious processes. However, there were worries about the patient's and the radiologist's excessive ionizing radiation exposure. [2, 3] The development of axial imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI), endoscopy, capsule endoscopy, and physiological monitoring rendered barium tests obsolete [3].

Following the injection of a barium contrast agent either orally or rectally, barium studies are specialized radiography exams used to diagnose various medical diseases of the gastrointestinal tract [4]. According to the target organ being checked, different types of barium examinations are categorized, including, barium swallow, barium meal, barium meal with follow through, barium enema [5].

The esophagus and throat are specifically examined using barium swallow [5]. Barium meal is essentially used in combination with barium swallow. A barium meal is a specialized radiographic examination of the stomach and small intestine's beginning. Usually in barium meal, a double contrast agent is used on adults to show the mucosal pattern, whereas a single contrast agent is utilized on kids and seriously sick adults. The small intestine is examined with a barium follow-through, and large intestine is examined with a barium enema. These two barium examinations are carried out with the use of a fluoroscope [6].

There are a number of conditions that warrant barium exams, including dysphagia, anemia, pain, esophageal carcinoma, neck mass, gastro-esophageal reflux, disease assessment of trachea-esophageal fistula, evaluation of the site of perforation, congenital esophageal stenosis, peptic ulcer, weight loss, upper abdominal mass, pyloric stenosis, vomiting, abdominal distention, gastro-intestinal hemorrhage, constipation, diarrhea, malabsorption, partial obstruction, abdominal mass, Crohn's diseases, fail small bowel enema, change in bowel habit, and ano-rectal mass [5, 7, 8, 9].

In recent years, a variety of sophisticated imaging modalities such as high resolution ultrasonography, endoscopy, colonoscopy, computed tomography (CT scan), magnetic resonance imaging (MRI), and defecography have increasingly replaced barium examinations to a greater extent [10]. Nevertheless, in the examination of motility problems, sub-mucosal lesions, and extrinsic pathology, barium swallows still outperform endoscopy, manometry, and 24-hour esophageal pH monitoring, even if they are equally useful diagnostic methods in the evaluation of esophageal diseases [8, 11]

Objective: The main aim of this study is to review the various forms of barium studies

2.0 METHODOLOGY

Relevant databases such as PubMed, Google Scholar and Embase to search for literature related to barium studies and cross sectional imaging were used for this study. Search strategy including keywords related to barium studies, cross-sectional imaging and low resource economies. This

may include terms such as barium swallow, barium meal, computed tomography, magnetic resonance imaging.

Inclusion Criteria

- Studies that compare the diagnostic accuracy of barium studies wih cross sectional imaging modalities such as computed tomography in evaluation of gastrointestinal disorders were included in this study
- Studies that evaluate the role of barium studies in low-resource economy
- Studies that discuss the potential benefits and limitations of barium studies in the diagnosis of GI tract disorders
- Studies that discuss the current state of barium studies and cross-sectional imaging modalities in low-resource economies and the challenges and opportunities for their implementation.

Exclusion criteria

- Studies that are not conducted in low resource economies were excluded from this study
- Studies that focus on the use of barium studies for non-GI tract disorders such as barium enema for colorectal cancer screening
- Studies that are not peer-reviewed or published in a journal

Various Forms of Barium Studies

Barium Swallow

The barium swallow study, usually referred to as an esophagram or barium esophagogram, is a contrast-enhanced radiography procedure that is frequently used to evaluate the structural and, to some degree, physiological aspects of the esophagus [12]. The diagnosis of a variety of diseases, such as esophageal motility problems, strictures, and perforations, may be made using a barium swallow study. Additionally, it can be used to describe disease that is located further away, including hiatal hernias, gastroesophageal reflux, or gastric volvulus [13]. Other indications for a barium swallow examination could also include dysphagia, webs, inability of endoscopy to pass strictures or growth, to assess the distal extent of malignancies, and to rule out surgical perforations [10]. A barium swallow study can be performed to evaluate and learn more about the pharyngeal level of the swallowing process [14]. Because the barium esophagogram can be done quickly and non-invasively with simple radiography still images and contrast material, as such it is still a helpful means of assessment despite the wide availability of CT imaging [15]. More so, better contrast pictures are produced using barium [15].

Single Contrast Barium Swallow

In one comparison, the only radio-opaque substance utilized is barium solution. For optimal assessment, the image must be exposed in at least two dimensions (A.P and lateral views). It is necessary to visualize the whole esophagus in both lateral and AP views. Evidence that the esophagus is full with barium is required. Films for mucosal relief should also be used. With the movement of barium from the esophagus to the stomach, the gastroesophageal junction should show signs of relaxation. Examining the esophagus for reflux and motility issues [15]

Figure 1a: Oesophageal stricture on single contrast barium swallow [14]

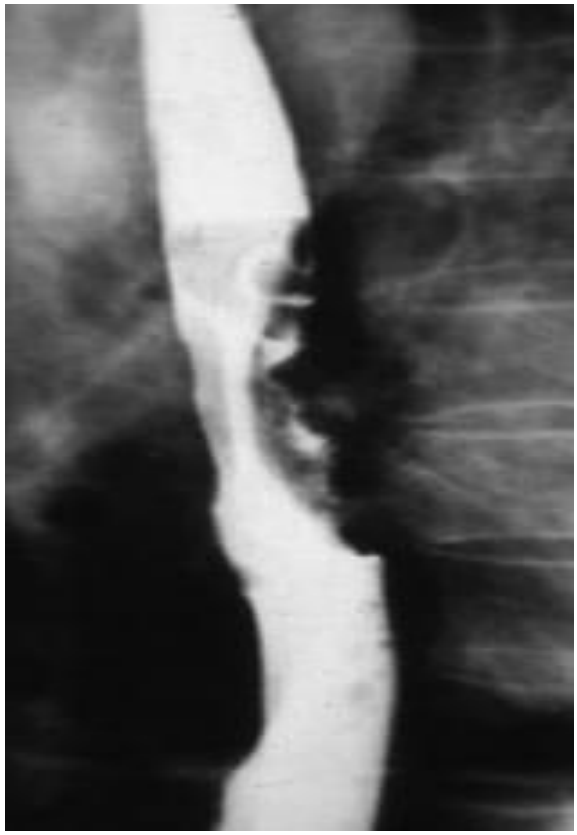

Figure 1b: Oesophageal carcinoma on single contrast barium swallow [14]

Double Contrast Barium Swallow

The oesophagus is stretched using a barium solution and air in contrast. Double contrast investigations enable greater visualization of smaller lesions. For optimal assessment, the image must be exposed in at least two dimensions (A.P and lateral views). It is necessary to visualize the whole esophagus in both lateral and AP views. It must be shown that the esophagus is barium-filled, and mucosal relief films should also be taken. With the movement of barium from the esophagus to the stomach, the gastro-esophageal junction should show signs of relaxation. Examining the esophagus for reflux and motility issues [15]

Figure 2: Double Contrast Barium Enema Showing Oesophageal Carcinoma with Mucosa Distortion. Researchgate.com

Barium Meal with Follow Through

A particular kind of imaging method in medicine is a barium follow-through procedure. It is employed in assessing the small bowel lesions [10].

Examination

The patient consumes a barium sulphate-containing contrast agent. On x-rays, this contrast material appears white and highlights the bowel's interior lining. As the contrast travels through the intestine, X-ray images are typically acquired at 0 minutes, 20 minutes, 40 minutes, and 90 minutes. This makes it possible for the radiologist to evaluate the bowel as it becomes apparent. When the barium can be seen in the terminal ileum and caecum, which represent the start of the large bowel, the test is considered to be finished. Imaging of this structure is essential because it is one of the locations where intestinal pathology is most frequently identified. Due to the wide variation in intestinal motility, the test duration varies from patient to patient. Although it could appear paler than usual, barium is not poisonous and is generally passed out as a stool [10].

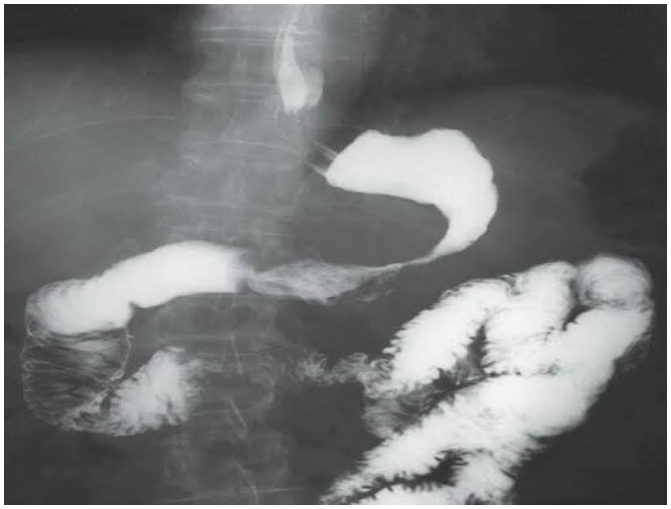

Figure 3a: Single Contrast Barium Meal and Follow Through Showing Linitis Listica. Pinterest.Com

Figure 3b: Double Contrast Barium Meal and Follow Through Showing Sclerodama. Radiopedia.Com

Barium Enema

Despite the advancements in cross-sectional imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI), the barium enema remains a valuable and unique diagnostic tool that provides doctors with specific and insightful information about the patient [6]. Barium enema is used for the examination of the lower gastrointestinal tract (the large intestine and the rectum) [6]. The double-contrast barium enema and the single-contrast barium enema are the two different forms of barium enema [6]. While single-contrast enema studies offer unique real-time information on colonic leaks and fistulas for patients with inflammatory bowel illness or in the postoperative setting, double-contrast barium enema studies are most frequently utilized as a screening assessment for colonic cancer [6]. It is important to note that inflammatory polyps, fissures, and fistulas that are characteristic of inflammatory bowel disease can be seen during a double-contrast barium enema examination [6]. Prior to a coloplasty, barium enemas are frequently recommended for preoperative colon and caecal assessment. A typical referral are post-operative loopograms to assess the distal colon [10]. Barium enemas are also used instead, when a colonoscopy is not possible owing to patient cooperation or technical reasons or after a failed colonoscopy [10].

Figure 4a: Ulcerative Colitis on Single Contrast Barium Enema. Medscape.Com

Figure 4b: Crohn's Disease on Double Contrast Barium Enema. Researchgate.Com

Advantages of Barium Examinations

Barium studies continue to be the safest, quickest, and least expensive diagnostic test to investigate hazy abdominal symptoms, hence the practice has to be resurrected. [17, 18] Barium investigations are the best and fastest way to diagnose gastrointestinal motility abnormalities, including submucosal lesions and pharynx to anus lesions. The use of traditional barium evaluation tends to be less accurate, slower [17, 18]. It is beyond dispute that patients with malabsorption benefit from a barium examination of the bowel. It is helpful for both diagnostic purposes as well as follow-up to assess treatment response. [18, 19]. Barium investigations are necessary for correct anatomical depiction in other fields as well, including speech therapy, the ear, nose, and throat, and the evaluation of prosthetic voice boxes as well as other benign disorders like diverticula. They benefit greatly from the barium's real-time evaluation of the upper digestive tract because it clarifies numerous confusing problems. However, practically all esophageal problems can be identified by a barium swallow examination for esophageal cancer staging purposes. No other less expensive modality may make this claim. Barium studies are short, less expensive investigations that are used in gastroenterology to assess postoperative complications, postoperative status, and response to treatment. [20] Before closing an external bowel diversion, loopograms (distal and proximal) are often done using barium in some facilities [21].

A rapid and safe screening test called the barium swallow can detect dysphagia, motility disorders, and post-operative assessment issues. In comparison to endoscopy, the barium swallow procedure is also more comfortable for the patient [8]. CT scans are used increasingly frequently in place of

barium meals, however its availability and accessibility is still very challenging in low resource economy like Nigeria During assessments, only double contrast Barium investigations can reveal stomach mucosal morphology such as fold convergence, depressions, surface raised lesions such as adenomas, and ulcers [8].

Limitations of Barium Examinations

Accurate anatomical representation was made possible by a number of modifications to the composition of barium and its procedures (high density, double contrast). Image intensification, automatic exposure, automatic film processor systems, and other technological advancements made it easier to complete these laborious processes. However, there were worries about the patient's and the radiologist's excessive ionizing radiation exposure. [2,3] The development of axial imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI), endoscopy, capsule endoscopy, and physiological monitoring rendered barium tests obsolete [2, 3].

Due to the aforementioned factors, requests for barium examinations have steadily decreased over the past 30 years in Nigeria. Today, only teaching institutions and rural locations with a lack of contemporary imaging resources undertake barium meal evaluations of the stomach and small bowel. In no significant institution is the skill of barium examination frequently practiced. There is no time to learn this art because it takes practice and a decreasing number of inquiries. Being operator dependent, clinicians would not trust the research done by junior radiologists and instead look to the range of other accessible investigations to find the answers. Learning the craft of barium examination takes time, and based on the state of poor economic condition of Nigeria, it is not cost-effective [22]. There aren't many senior radiologists who are proficient enough to instruct. With time, no one would be capable of conducting a suitable and effective barium examination. Additionally, the current generation of radiologists and physicians rely more on axial imaging and endoscopy and do not want to spend more time performing time-consuming barium exams [23].

3.0 CONCLUSION AND RECOMMENDATIONS

Conclusion

Conventional Barium examinations still have a purpose in determining the state of the mucosa, diameter of the lumen, degree, and type of obstruction even though CT and MRI have essentially superseded them. Additionally, barium offers live data on intestinal transit duration and motility. On a CT scan, these characteristics are not visible. Additionally, it is the preferred research for individuals with precancerous lesions or Crohn's disease who need to do repeated examinations.

Recommendation

Although the number of barium examinations may at first decrease, they will eventually level off as the referral pattern adapts to the diagnostic challenges faced by both clinicians and cross sectional radiologists. To prevent this modality from going extinct and ultimately harming patients, teaching institutions should encourage radiologists to become conversant with Barium studies.

Suggestion for Further Studies

Further research should be conducted retrospectively using medical records from hospitals across Nigeria to determine the nature of adverse effects such as bowel perforation or allergic reactions following barium enema tests.

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