JKM
Sai Wawai

Jurnal Kesehatan Metro Sai Wawai
Vol. 18, No. 1, June 2025. DOI: https://doi.org/10.26630/jkmsw.v18i1.5018
Journal homepage https://ejurnal.poltekkes-tjk.ac.id/index.php/JKM
Email: jkm@poltekkes-tjk.ac.id

ISSN Online
2657-1390
ISSN Print
19779-469X

Radiologic Technique for Esophagus, Stomach, and Duodenum Examination in Dysphagia Cases: A Case Study at Panembahan Senopati Bantul Hospital

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ARTICLE INFO

Article history

Submitted: 30 May 2025

Revise: 23 June 2025

Accepted: 25 June 2025

Keywords:

Oesophagus, Duodenum examination, Dysphagia, Radiology Examination

ABSTRACT

Dysphagia, or difficulty swallowing, is a common clinical symptom that often reflects structural or functional abnormalities of the upper gastrointestinal (GI) tract. Accurate imaging of the esophagus, stomach, and duodenum (ESD) is essential for identifying the underlying causes. This study aimed to describe radiologic examination techniques for ESD assessment in dysphagia cases at the Radiology Department of Panembahan Senopati Bantul Hospital. A qualitative case study design was applied, involving one radiologist and three radiographers. Data were obtained through direct observation, in-depth interviews, and document analysis, and processed using data reduction, categorization, and open coding, then validated with relevant radiologic literature.

Patient preparation included 6–8 hours of fasting, removal of metallic objects, and procedural explanation. Imaging was performed in stages: the stomach was evaluated with AP supine and PA prone projections, the esophagus with AP erect and RPO projections, and the duodenum with an AP full-filling projection. Projection selection was guided by clinical indication, patient comfort, and technical efficiency. For example, AP and RPO projections were sufficient for esophageal evaluation due to its small diameter. The AP supine view was used to assess the corpus ventriculi, while PA prone provided better visualization of the fundus.

All examinations were performed under radiologist supervision and adjusted based on patient condition and available equipment. Additional projections were unnecessary if no abnormalities were detected. In conclusion, ESD examination for dysphagia at this hospital follows a systematic yet flexible protocol, ensuring diagnostic accuracy while maintaining patient safety and comfort.

INTRODUCTION

The swallowing process is a complex neuromuscular activity, involving the coordination of about 40 pairs of muscles and 5 cranial nerves. It moves a bolus of food or liquid from the mouth to the stomach through the throat and esophagus. Swallowing consists of three main stages: the oral stage (preparation and propulsion of the bolus), the pharyngeal stage (passing through the throat), and the esophageal stage (movement through the esophagus towards the stomach) (Matsuo & Palmer, 2008; Wei et al., 2023). Dysphagia is a swallowing disorder caused by structural or functional abnormalities of the mouth, pharynx or esophagus (Babbar et al., 2025), A serious complication of dysphagia is aspiration, which is the entry of a bolus into the airway, which can occur without a cough reflex (silent aspiration) and is difficult to detect (Suresh & Dhar, 2025). Dysphagia is characterized by symptoms such as difficulty chewing, food residue in the mouth, a feeling of being stuck in the throat, coughing during or after meals, unexplained weight loss, and vomiting. The disorder can be experienced at any age, but is more common in people over the age of 50, accounting for 7-22% of the world's population. The

prevalence of dysphagia in the general population is around 20% and 50-66% in the elderly over 60 years (Thiyagalingam et al., 2021; Tulunay-Ugur & Eibling, 2018).

The pathology of dysphagia can be determined by performing an Esophagus Stomach Duodenum examination (ESD) examination is an examination. Radiography that aims to see anatomical and physiological abnormalities of the esophagus, stomach and duodenum using contrast material. this examination is usually performed to diagnose diseases of the upper digestive system (Patel et al., 2023). Radiology installation at RSUD Panembahan Senopati Bantul as one of the health centres that has a great responsibility in the diagnosis and treatment of patients with Dysphagia cases. Based on the author's observations during the PKL at Panembahan Senopati Bantul Hospital, in 10 weeks of PKL the number of patients with ESD examination was 4-6 patients. With the increase in the number of patients treated for upper gastrointestinal disorders, the application of the Esophagus Stomach Duodenum technique is expected to make a significant contribution to the quality of radiology services. an Esophagus Stomach Duodenum (ESD) not only allows early detection of Dysphagia cases, but can also help in staging the disease and monitoring response to therapy.

ESD examination at Panembahan Senopati Bantul Hospital uses AP supine and PA prone projections for stomach, AP erect and RPO for esophagus, and AP for duodenum. According to (Antunes & Sloan, 2023), ESD examination should include RAO, lateral, AP/PA, and LAO projections for esophagus, as well as RAO, PA, right lateral, LPO, and AP for stomach - duodenum. The contrast media entry method is divided into single contrast (using $BaSO_4$) and double contrast (using a mixture of $BaSO_4$ and water), with a concentration of 60% w/v for dilute contrast and 98% w/v for concentrated contrast. Positive contrast media is inserted through the mouth, while negative contrast media is used to produce gas. According to (Summerton, 2005), ESD examination using AP and LPO projections for the esophagus, and supine AP and prone PA for the stomach and duodenum. Contrast media was administered gradually with the double contrast method using $BaSO_4$ dissolved in soda water.

The study was conducted which aims to determine how the procedure of esophagus–stomach–duodenum (ESD) technique in Dysphagia cases at Radiology Installation of Senopati Bantul Addition Hospital. To find out why ESD examination in Dysphagia cases at Radiology Installation of Senopati Bantul Hospital only uses PAsupine projection and AP prone for stomach, Antero Posterior (AP) erect and RPO, for esophagus and AP for duodenum .To find out how the technique of inserting contrast media in Esophagus Stomach Duodenum examination in Dysphagia cases at Radiology Installation of Senopati Bantul Hospital. This study aims to describe and evaluate the radiographic technique used in esophagus–stomach–duodenum (ESD) examinations for dysphagia cases at the Radiology Department of Panembahan Senopati Hospital, Bantul, and to compare its application with recommended clinical standards.

METHOD

This type of research is qualitative with a case study approach in the Radiology Installation of Panembahan Senopati Bantul General Hospital. The time of data collection was on 12 September 2024-30 April 2025. The subjects of this study were 1 radiologist, and 3 radiographers. focus of this studyis Case Study of Esophagus Stomach Duodenum Clinical Dysphagia Examination Technique in Radiology Installation of Panembahan Senopati Bantul General Hospital.

Data was collected through observation, interview and documentation methods. Observation guidelines were used to make observations. Interviews were conducted with, interviews were conducted using semi such as 1 radiologist, and 3 radiographers then documentation of the results of data collection that has been carried out and will be continued with the analysis and presentation of data which will be drawn conclusions. The data were

analyzed through data reduction, categorization, and open coding. The findings were confirmed through theoretical triangulation and presented in narrative and visual formats. Validity was ensured through source triangulation and researcher cross-checks

This study received ethical clearance from the Research Ethics Committee of Universitas 'Aisyiyah Yogyakarta (No.209/KEP-UNISA/EC/III/2025), allowing the research to proceed in compliance with ethical standards involving human participants.

RESULTS

1. Case Identity

Based on the results of the author's observations of the data obtained after taking and collecting data regarding the implementation of the Esophagus Stomach Duodenum examination at the Radiology Installation of Panembahan Senopati Bantul Hospital, the following results were obtained:

a. Patient Identity

Table 1. Patient's Identity

Name	:	Mr.S
Gender	:	Male
Age	:	Plembutan, Bantul
Adress	:	62 y.o
Room	:	Fluroscopy
Radiograph Number	:	24xxxx
Medical Record Number	:	37xxxx
Date of Examination	:	12 September 2025
Examination	:	Esophagus Stomach Duodenum
Sending Doctor	:	dr. Xxxx, Sp.PD

b. Patient's Medical History

Before undergoing the Esophagus–Stomach–Duodenum (ESD) examination at the Radiology Department, the patient first visited the Internal Medicine Clinic on 10 September with complaints of difficulty swallowing accompanied by excessive salivation that had persisted for approximately three weeks. Clinical evaluation revealed signs consistent with dysphagia, prompting the physician to issue a referral for radiographic assessment of the ESD region.

On 12 September, the patient, hereafter referred to as patient S, presented to the Radiology Department for the requested procedure. The examination aimed to evaluate the esophagus, stomach, and duodenum using a contrast radiographic study to identify possible causes of dysphagia such as strictures, motility disorders, or obstructive lesions.

Prior to imaging, the patient underwent standard preparation, including 6–8 hours of fasting to ensure optimal mucosal coating by the contrast medium. During the procedure, a barium-based suspension was administered, and imaging was performed in sequential stages under the supervision of a radiologist. For the esophagus, AP erect and RPO projections were acquired to visualize mucosal patterns and swallowing function. For the stomach, AP supine and PA prone projections were obtained to evaluate the corpus ventriculi and gastric fundus. For the duodenum, an AP full-filling projection was performed to ensure adequate distension and luminal visualization. Projection choices were guided by clinical indications, patient tolerance, and equipment availability.

The resulting images demonstrated smooth mucosal surfaces, adequate gastric distension, and continuous passage of contrast into the duodenum without evidence of obstruction, stricture, or impaired motility. This case highlights the integration of clinical findings with radiologic evaluation in patients presenting with dysphagia. The systematic use of contrast radiography provided essential information on esophageal transit, gastric morphology, and duodenal patency, thereby confirming the absence of significant structural abnormalities.

2. Esophagus Stomach Duodenum examination procedure in Dysphagia cases at Radiology Installation of Panembahan Senopati Bantul Hospital

The ESD examination procedure at the Radiology Installation of Panembahan Senopati Bantul Hospital begins with patient preparation. Patients are required to fast for 6 to 8 hours prior to the examination, although they are still allowed to drink water during this fasting period. Tool preparation includes one unit of a fluoroscopy machine, specifically the Siemens Health Expert model, along with basic accessories such as a spoon, glass, and straws to assist in the administration of contrast material. For the preparation of materials, the contrast agent used is Barium Sulfate ($BaSO_4$). In addition, Ademsari brand carbonated drinks and Aqua brand water are used as solvents. The mixture ratio of $BaSO_4$ and solvent varies depending on the organ being examined: a 2:1 ratio for the stomach (ulcer region), 1:1 for the esophagus, and 1:6 for the duodenum. These preparations ensure optimal imaging quality and patient safety during the ESD examination.

Table 1.Examination procedure table Esophagus Stomach Duodenum

No	Stages	Details
1	Patient Preparation	Patient preparation for ESD Examination at Panembahan Senopati Bantul Hospital is fasting for 6-8 Hours before the examination. Patients are only allowed to drink water
2	Tool Preparation	a. One unit of fluoroscopy aircraft b. Siemens brand health expert c. Spoon d. Glass e. Straws
3	Preparation Of Materials	The Contrast Material Used In The ESD Examination at the Radiology Installation Of Panembahan Senopati Bantul Hospital Uses Baso4, Ademsari brand carbonated drinks and aqua water as a solvent used for ulcers is 2:1, for esophagus 1:1 and for Duodenum 1:6.

3. Esophagus Stomch Duodenum examination technique in Dysphagia cases at Radiology Installation of Senopati Addition Hospital Bantul.

a. Projection Stomach Radiographs AP and PA

After taking a plain AP projection of the thorax, the first stage of the examination focuses on the stomach using the double contrast method. This method involves administering barium sulfate ($BaSO_4$) mixed with water in a ratio of 1:2 (50 ml $BaSO_4$ to 100 ml water), with a total volume of approximately 2 to 3 tablespoons. The patient, seated in an upright position, is asked to swallow the contrast medium. Following ingestion, the patient is instructed to perform rolling movements—rolling to the left side, then supine, and then to the right side to ensure that the entire surface of the stomach is evenly coated with the contrast material.

Next, the patient is given a negative contrast agent, consisting of one spoonful of Ademsari brand carbonated drink mixed with a small amount of water. The purpose of this negative contrast is to introduce gas into the stomach, causing it to expand and allowing better visualization of the gastric walls. The patient is again instructed to roll over gently so that the gas distributes evenly throughout the stomach. Throughout this process, the patient must avoid burping, as releasing gas would require the examination to be restarted from the beginning.

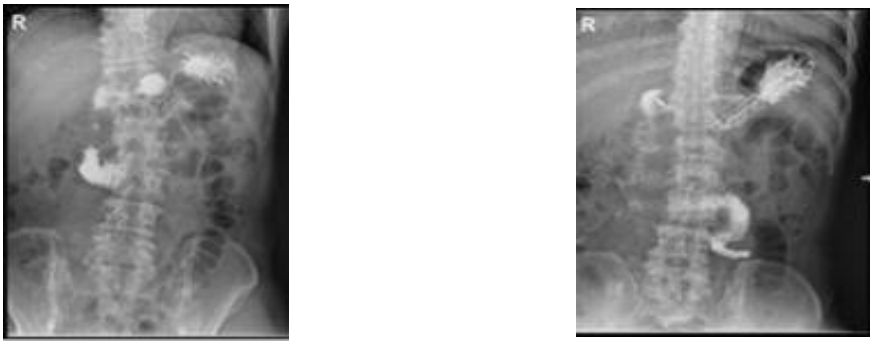
Once the contrast materials are evenly distributed, radiographic images of the stomach are taken in two projections: AP (supine) and PA (prone). For the supine AP projection, the patient lies on their back with the mid-sagittal plane (MSP) aligned in the center of the examination table. The central ray is directed perpendicularly to the cassette at the level of the first lumbar vertebra (L1), midway between the xiphoid process and the lower border of the ribs, with a focus-to-film distance (FFD) of 100 cm. For the prone PA projection, the patient lies

face down with the MSP centered on the table. The central ray is directed vertically perpendicular to the cassette at the L1 level, approximately 2 to 5 cm to the left of the vertebral column, also with an FFD of 100 cm. The resulting AP and PA stomach radiographs provide detailed images essential for diagnosing gastric conditions (see Radiography 1 below).

After an AP projection plain Thorax Radiograph is taken, after that, the first stage is an stomach examination with the double contrast method, which uses barium in a ratio of 1: 2 (50: 100), (BaSO4 and water) as much as 2 to 3 tablespoons. The patient in a sitting position is asked to swallow contrast media, then directed to do rolling movements (left side, stomach, right side, supine) so that the entire surface of the stomach is evenly coated with contrast.

Next, the patient is given negative contrast media in the form of 1 spoon of Ademsari brand carbonated drink mixed with a little water (Ademsari as negative contrast which aims to make the stomach area expand). The patient is again directed to roll over so that the gas from the negative contrast media is evenly distributed in the stomach. During this process, the patient is instructed not to burp. If they burp, the examination must be repeated from the beginning.

After the contrast medium is evenly distributed, radiographic imaging of the stomach is performed in both anteroposterior (AP, supine) and posteroanterior (PA, prone) projections. For the AP (supine) projection, the patient is positioned supine on the examination table with the midsagittal plane (MSP) aligned at the center of the table. The central ray is directed vertically and perpendicular to the image receptor, centered at the level of the first lumbar vertebra (L1), midway between the xiphoid process and the lower costal margin. The focus-film distance (FFD) is maintained at 100 cm. For the PA (prone) projection, the patient is positioned prone with the MSP aligned to the center of the table. The central ray is directed vertically and perpendicular to the image receptor, centered at the level of L1, approximately 2–5 cm to the left of the vertebral column. The FFD is also maintained at 100 cm. The resulting AP and PA radiographs of the stomach are presented in Radiograph 1 below.



(AP) **(PA)**

Figure 1. Results of AP and PA projection radiographs

b. AP erect and RPO projection Esophagus Radiography

The next step is the examination of the esophagus, which is performed using a single contrast technique. A concentrated barium sulfate ($BaSO_4$) suspension mixed with water in a 1:1 ratio (50 ml $BaSO_4$ to 50 ml water) is used as the contrast medium. The patient is given approximately 2 to 3 tablespoons of this barium mixture, which is initially held in the mouth. Upon receiving a signal from the radiographer, the patient swallows the contrast while fluoroscopic imaging begins immediately to observe the flow of the contrast medium through the esophagus in real time on the monitor. Two main projections are taken during the examination: an AP erect projection and a right posterior oblique (RPO) projection.

For the AP erect projection, the patient stands upright with their arms relaxed at their sides. The mid-sagittal plane (MSP) of the body is aligned with the center of the examination table. The central ray is directed perpendicularly to the cassette, targeting the thoracic

vertebrae 5–6, just inferior to the jugular notch. The focus-to-film distance (FFD) is set at 100 cm. For the oblique RPO projection, the patient remains standing with arms at their sides and is positioned with the MSP centered on the bucky stand. The patient's body is rotated 45 degrees to the right to provide the oblique view. The same concentration and volume of contrast media are administered following the same swallowing procedure while fluoroscopy captures the esophageal passage.

The resulting radiographs from both the AP erect and RPO projections provide detailed visualization of the esophagus, facilitating accurate assessment of its structure and function. Examples of these images can be found in Radiography 2 below.

(AP) **(RPO)**

Figure 2. Results of AP erect and RPO projection radiographs

c. AP Full Filing Projection Duodenum Radiograph

The final phase of the examination focused on radiographic evaluation of the duodenum using a diluted barium sulfate ($BaSO_4$) suspension. The contrast medium was prepared in a 1:6 ratio with water, and approximately 200–220 mL (equivalent to one full glass or more) was administered orally. The patient was instructed to drink the entire volume to ensure adequate coating and luminal filling.

Following ingestion, a full-filling anteroposterior (AP) projection was obtained. For this projection, the patient was positioned in an upright standing posture with both arms resting naturally at the sides. The midsagittal plane (MSP) of the body was carefully aligned with the midline of the examination table to achieve symmetrical positioning. The central ray was directed vertically, perpendicular to the image receptor, and centered at the level of the first lumbar vertebra (L1). This anatomical landmark corresponds to a point midway between the xiphoid process and the inferior costal margin, which provides an optimal reference for duodenal imaging. A focus-to-film distance (FFD) of 100 cm was consistently maintained during exposure to ensure image accuracy and minimize distortion.

The radiographic outcome of this phase of the examination is presented in Radiography 3 below.

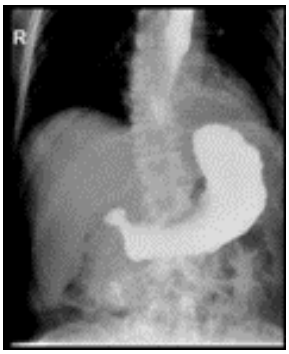


Figure 3. Results of AP Full-filing projection radiographs

d. Expertise
   1) Esophagus: Smooth passage of contrast, intact mucosal lining, and normal luminal caliber.
   2) Stomach (Gaster): Well-defined gastric curvature, normal mucosal pattern, and no evidence of the three-level sign.
   3) Duodenum: Normal mucosal appearance with smooth contrast flow and adequate drainage.

Impression: Esophago-gastro-duodenography (ESD) findings are within normal limits.

4. Contrast Media Administration Technique for Esophagus, Stomach, and Duodenum (ESD) Examination in Dysphagia Cases

Contrast media insertion technique in ESD examination at Radiology Installation of Panembahan Senopati Bantul Hospital is performed using double contrast technique for duodenal stomach examination and single contrast technique for esophagus examination. The examination begins with taking plain Radiograph. After that, the first stage is the stomach examination with the double contrast method, which uses barium in a ratio of 1:2 (BaSO4 and water) as much as 2 to 3 tablespoons. The patient in a sitting position is asked to swallow the contrast medium, then directed to do rolling movements (left side, stomach, right side, supine) so that the entire surface of the stomach is evenly coated with contrast.

Next, the patient is given negative contrast media in the form of 1 spoon of Ademsari brand carbonated drink mixed with a little water (Ademsari as negative contrast which aims to make the stomach area expand). The patient is again directed to roll over so that the gas from the negative contrast media is evenly distributed in the stomach. During this process, the patient is instructed not to burp. If they burp, the examination must be repeated from the beginning. After the contrast is evenly distributed, AP (supine) and PA (prone) ulcer projection Radiograph are taken.

The next step is an oesophageal examination using the single contrast technique, with a concentrated contrast medium of 1:1 (50:50) BaSO4 and water. The patient is given about 2-3 tablespoons of barium, held in the mouth first. After being given a signal to swallow by the radiographer, the patient swallows the contrast and immediately exposes using fluoroscopy. The projections taken are AP erect and oblique RPO, while viewing the flow of contrast passage through the esophagus in real time on the monitor screen.

The last examination was the duodenum, using diluted BaSO4 in a ratio of 1:6 (BaSO4 and water), about one full glass (200-220 ml or more). The patient was asked to drink until the end, the waiting time for contrast media to enter was about 3 minutes, then full filing AP projection Radiographs were taken. The examination was closed by consulting the results to the doctor for further evaluation.

5. Reasons for Esophagus Stomach Duodenum examination using AP supine and PA prone projection for stomach; AP erect, RPO for Esophagus and AP for Duodenum

Based on interviews conducted by the author with respondents regarding the examination of the esophagus, stomach, and duodenum in cases of dysphagia at the Radiology Installation of Panembahan Senopati Bantul Hospital, the esophago-gastro-duodenography (ESD) procedure was performed using projections selected according to clinical indications, patient comfort, technical feasibility, and the availability of equipment.

For the esophagus, anteroposterior (AP) erect and right posterior oblique (RPO) erect projections were routinely employed. These were considered sufficient to evaluate the esophageal structure given its relatively narrow lumen. Additional projections, such as left posterior oblique (LPO), were performed when clinically indicated and after consultation with the physician. The RPO projection was preferred due to the supportive positioning of the

equipment and greater patient comfort, particularly in elderly individuals or those with limited mobility.

For the stomach, the supine AP projection was utilized to visualize the corpus ventriculi, while the prone PA projection provided clearer delineation of the gastric fundus, which lies closer to the examination table in this position. Additional projections were not deemed necessary unless specific clinical indications were present. For the duodenum, a full-filling AP projection was obtained to evaluate adequate contrast medium distribution and mucosal visualization.

DISCUSSION

1. Appropriateness of Technique Compared to Literature on Esophagus, Stomach, and Duodenum (ESD) Examination in Clinical Dysphagia Cases at the Radiology Department of Panembahan Senopati Bantul Hospital

a. Patient Preparation

Patient preparation at the Radiology Department of Panembahan Senopati Bantul Hospital, as described by Radiographer Mr. S, involves fasting for 6–8 hours prior to the ESD examination. This is consistent with the recommendation by (Summerton, 2005), who emphasizes that patients should fast for 8–9 hours to ensure an empty stomach and to avoid smoking, as smoking stimulates gastric secretions and increases saliva production.

Terra et al. (2021) also recommend an 8-hour fasting period, a low-fiber diet (such as soy sauce porridge), and abstinence from smoking. Furthermore, (Antunes & Sloan, 2023) added that patients should remove metal objects and clothing to avoid radiographic artifacts and should receive a clear explanation of the procedure. In conclusion, patient preparation procedures at Panembahan Senopati Bantul Hospital are generally in accordance with established guidelines, particularly in terms of fasting, removal of metallic items, and providing procedural explanations to the patient undergoing ESD for dysphagia.

b. Preparation of Equipment and Materials

Equipment and materials prepared at the Radiology Department include: an X-ray unit with fluoroscopy capabilities, 35 × 43 cm image receptor, barium sulfate ($BaSO_4$) contrast medium, carbonated drink (Adem Sari) as a negative contrast, as well as basic accessories such as glasses, spoons, straws, and patient gowns. According to (Sala & Freeman, 2007), the standard equipment includes a fluoroscopy-compatible X-ray machine, image grids, both positive ($BaSO_4$) and negative contrast agents (CO_2 or air), patient attire, straws, and other tools for administration. Gore & Levine (2015) support the use of computed radiography, Sprite as a gas-producing agent, and basic utensils. McKay & Garza (2023) mention the use of a DK-brand fluoroscopy system, contrast media containers, measuring cups, and a computer-printer system.

The author concludes that despite variations in the type of negative contrast media used, the overall preparation at Panembahan Senopati Bantul Hospital is in line with theoretical references, meeting the technical and clinical requirements for ESD examination.

c. Radiographic Technique

The sequence of projections used at Panembahan Senopati Bantul Hospital begins with the esophagus (AP projection), followed by the stomach (AP supine and PA prone), and concluding with the duodenum (AP erect full-filling projection). In contrast, (Terra et al., 2021) recommend a more comprehensive projection set: RAO, lateral, AP/PA, and LAO for esophagus evaluation, and RAO, PA, right lateral, LPO, and AP for the stomach and duodenum.

Sala & Freeman (2007) recommend the use of AP and PA projections to optimize visualization of gastric filling, while AP erect and LPO projections are suggested for esophageal evaluation to minimize spinal superimposition. More recently, Antunes & Sloan, (2023) proposed the use of AP and LPO projections for the esophagus, as well as AP supine and PA prone projections for the stomach and duodenum.

Based on comparison, the radiographic protocol at Panembahan Senopati Bantul Hospital is partially aligned with recommended standards, but it lacks projection diversity, particularly in esophageal imaging. The institutional practice begins with stomach imaging, differing from conventional esophageal-first approaches. However, the selected projections have been deemed clinically sufficient for the diagnostic needs and common dysphagia presentations encountered in this setting. Additionally, the limited number of projections contributes to improved patient comfort, particularly for elderly individuals or those with reduced mobility.

d. Contrast Media Administration Technique

The ESD examination protocol at Panembahan Senopati Bantul Hospital begins with preliminary anteroposterior (AP) radiographs of the esophagus, followed by contrast administration. The gastric phase is performed first, in which patients receive 2–3 tablespoons of a diluted barium sulfate ($BaSO_4$) suspension (1:2 ratio) and are instructed to perform rotational maneuvers to achieve uniform mucosal coating. Subsequently, a carbonated beverage (Adem Sari®) is administered as a negative contrast medium to promote gastric distension. Imaging is then obtained in AP supine and posteroanterior (PA) prone projections.

In the esophageal phase, a concentrated $BaSO_4$ suspension (1:1 ratio) is administered. The patient holds the contrast medium in the oral cavity and swallows upon instruction while fluoroscopy provides real-time dynamic assessment. Radiographs are acquired in AP erect and right posterior oblique (RPO) projections. For the duodenum, the patient ingests approximately 200 mL of a diluted $BaSO_4$ suspension (1:6 ratio), followed by an AP erect full-filling projection. The examination concludes with consultation and image interpretation by a radiologist, with additional projections performed when clinically indicated.

In comparison, describe a staged double-contrast method involving $BaSO_4$ combined with soda water, using thick suspensions for the esophagus and thin suspensions for the stomach and duodenum. Hapfari et al. (2024) report that the esophagus is commonly examined using a 1:1 $BaSO_4$ single-contrast technique, while the stomach and duodenum are evaluated with a 1:4 $BaSO_4$ suspension supplemented with air. Similarly, recommend 98% w/v $BaSO_4$ (3:1 or 4:1 concentration) for esophageal imaging, and 60% w/v $BaSO_4$ for stomach and duodenal studies, in combination with negative contrast agents such as air, CO_2 crystals, or gas bubbles.

Overall, the technique employed at Panembahan Senopati Bantul Hospital demonstrates general alignment with established theoretical standards, though variations exist in contrast ratios and the selection of negative contrast media. The use of a carbonated drink (Adem Sari®) as a gas-producing agent differs from conventional agents such as air or CO_2, but nonetheless provides effective gastric distension. The application of fluoroscopy enhances diagnostic accuracy by enabling simultaneous anatomical and functional evaluation. Although the contrast concentrations and volumes differ from textbook protocols, they remain clinically acceptable and yield satisfactory diagnostic image quality.

2. Clinical and Practical Rationale for Technique Modification in Esophagus, Stomach, and Duodenum (ESD) Examination for Dysphagia Cases at the Radiology Department of Panembahan Senopati Bantul Hospital

The modification of the ESD examination technique at the Radiology Department of Panembahan Senopati Bantul Hospital is driven by both clinical necessity and practical field

considerations. From a clinical perspective, the selection of AP supine and PA prone projections for the stomach, AP erect and right posterior oblique (RPO) for the esophagus, and AP full-filling for the duodenum has been shown to provide diagnostically adequate imaging for evaluating upper gastrointestinal tract disorders, particularly in cases of dysphagia.

These projections enable effective visualization of key anatomical regions such as the corpus ventriculi, gastric fundus, and contrast distribution within the duodenal lumen. The RPO projection, in particular, is favored for esophageal evaluation due to its diagnostic clarity, especially in patients with positional or mobility limitations.

From a practical standpoint, this projection protocol emphasizes patient comfort, operational efficiency, and space limitations, especially in the care of geriatric patients or those with impaired mobility. The RPO view is easier to perform, reduces examination time, and minimizes physical burden on the patient. Moreover, the examination sequence beginning with the stomach rather than the esophagus is intended to enhance patient comfort by minimizing prolonged gas retention or burping suppression during the procedure.

These technical modifications are also informed by radiologist preferences and radiographer workflow practices, which have proven effective for common clinical presentations. Anggraeni & Istiqomah (2024) support this approach, noting that the use of non-standard projections such as RPO is clinically justified when adapting to patient positioning challenges. They assert that RPO provides clearer esophageal visualization than LPO in certain cases. Similarly, Bau-Bau et al. (2024) emphasize the utility of AP and PA gastric views and AP erect and LPO esophageal views for optimizing contrast delineation.

3. Clinical Impact of the Modified ESD Technique in Dysphagia Cases

The modified ESD technique employed at the Radiology Department of Panembahan Senopati Bantul Hospital demonstrates favorable clinical outcomes in terms of anatomical visualization and diagnostic accuracy for upper gastrointestinal (GI) disorders, including dysphagia. This approach aligns with previous studies that emphasize the importance of adapting fluoroscopic techniques to patient-specific factors and clinical indications. The use of a simplified yet targeted projection set—AP supine and PA prone for the stomach, AP erect and RPO for the esophagus, and AP full-filling for the duodenum—has been sufficient to yield diagnostically valuable images, especially when optimized through real-time assessment and tailored contrast administration.

Based on radiologist interpretations, esophageal imaging revealed normal mucosal patterns, smooth barium transit, and a uniform lumen. The combined use of fluoroscopy and thick contrast media in AP erect and RPO projections enabled real-time assessment of esophageal motility and structural integrity. This is consistent with recommendations by the American College of Radiology (ACR), which highlight the importance of biphasic contrast studies and oblique projections for optimal esophageal visualization in dysphagia evaluation (ACR Appropriateness Criteria®, 2020). The RPO view, in particular, is known to offer superior delineation of the esophageal contour and detection of subtle strictures or motility disorders (sandradilla et al., 2024).

In gastric imaging, the curvature and mucosal lining were clearly visualized, and no signs of gastric retention or mucosal disruption were noted. The absence of a “three-level sign” further supported the normal appearance of the gastric wall, as this sign is typically associated with mechanical obstruction or ileus (Levy et al., 2019). The use of diluted barium sulfate in conjunction with a carbonated negative contrast agent ensured uniform coating of the gastric mucosa, aiding in the optimal delineation of the fundus and corpus ventriculi. This technique is supported by studies showing that effervescent agents improve mucosal visualization and help detect subtle lesions such as erosions or early ulcers (Bau-bau et al., 2024).

For the duodenum, contrast flow was observed to be smooth and complete. The use of a full-filling AP projection, coupled with a sufficient volume of diluted $BaSO_4$ (approximately one

glass), provided clear images that showed complete luminal opacification without obstruction. This finding is in line with conventional fluoroscopic principles, which emphasize the importance of appropriate contrast volume and projection angle in ensuring proper duodenal distension and transit visualization (Bau-bau et al., 2024).

Overall, the modified ESD protocol provided adequate diagnostic visualization, despite deviations from traditional textbook methodologies. These adjustments reflect the practical integration of evidence-based radiographic techniques tailored to local clinical resources and patient tolerance. As shown in prior research, modified protocols can maintain diagnostic quality while enhancing patient compliance and operational efficiency in resource-limited settings (Antunes & Sloan, 2023; Erkonen & Smith, 2010). The outcomes confirm that the applied technique, though simplified, is clinically sufficient and diagnostically appropriate for evaluating upper GI disorders, especially dysphagia.

4. Recommendations for Improving the ESD Examination Technique for Dysphagia Cases

To further enhance the quality and diagnostic value of ESD examinations at the Radiology Department of Panembahan Senopati Bantul Hospital, it is recommended that the Right Anterior Oblique (RAO) projection be incorporated, particularly for esophageal imaging. The RAO projection is widely recognized for minimizing superimposition of the esophagus with the vertebral column and cardiac silhouette, thereby offering superior delineation of esophageal anatomy. This is especially important for detecting pathological conditions such as strictures, diverticula, neoplasms, or external compressions.

In addition, the sequence of the examination should follow the anatomical and physiological progression of the gastrointestinal tract: beginning with the esophagus, followed by the stomach, and concluding with the duodenum. This standardized sequence enhances the logical flow of image interpretation, promotes systematic evaluation, and allows for better correlation of radiologic findings with clinical symptoms. Adopting this order also aligns with international radiologic examination protocols, contributing to higher diagnostic precision and workflow consistency.

By implementing these improvements, particularly the inclusion of RAO projection and anatomically aligned sequencing, the radiology department can optimize both clinical outcomes and operational efficiency, ultimately enhancing the diagnostic accuracy in patients presenting with dysphagia.

CONCLUSION

Esophagus, stomach, and duodenum (ESD) examination procedures in the Radiology Installation of Panembahan Senopati Bantul Hospital in dysphagia cases are mostly in accordance with gastrointestinal radiology standards, both in terms of patient preparation, use of contrast media, and imaging projections. However, there are two main differences compared to theory: (1) the order of examination starts from the ulcer, not the esophagus according to anatomical order; and (2) RAO projection, which is theoretically optimal for visualization of the esophagus, has not been used routinely, replaced by RPO projection.

Such differences can be justified clinically on the grounds of patient comfort and procedure efficiency. Ulcer examination is performed earlier to prevent discomfort due to retained belching, whereas the RPO projection is considered sufficient in depicting oesophageal structures in most cases. However, diagnostically, this approach can still be improved by considering anatomical standards and more accurate projection techniques.

AUTHOR'S DECLARATION

Authors' contributions and responsibilities

DFK & ANI : Writing Original Draft, Visualization, Conceptualization, Data Collection.
AM: Writing by Supporting Draft, Review and Editing.

Funding

This research was funded by the authors' personal funds.

Availability of data and materials

All data and supporting materials for this study are available and can be requested directly from the corresponding author.

Competing interests

The authors declare no conflict of interest in the conduct or reporting of this research.

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to the Radiology Installation team at Panembahan Senopati Bantul Hospital for their valuable support and assistance during the data collection process. Special thanks are extended to the radiographers and medical personnel involved in the Esophagus-Stomach-Duodenum (ESD) examination procedures for their cooperation and willingness to share practical insights, which greatly enriched this study. Finally, heartfelt appreciation is given to the patients who participated in this study, for their consent and contribution, which made this research possible.

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