

Advancing Practice: Nursing Perspectives in Capsule Endoscopy and New GI Technologies

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Abstract: Capsule endoscopy is a noninvasive diagnostic tool that allows direct visualization of the gastrointestinal (GI) tract using a swallowable, camera-equipped capsule [1]. It has revolutionized the evaluation of small bowel diseases such as obscure gastrointestinal bleeding, Crohn's disease, celiac disease, and small bowel tumors [4]. With the integration of Artificial Intelligence (AI), the diagnostic process has become faster, more accurate, and less dependent on manual image review. Nurses play a vital role in patient preparation, procedure monitoring, and post-procedure data management. Their training and active participation ensure patient safety, comfort, and efficiency throughout the process. This paper discusses the principles of capsule endoscopy, the integration of AI in diagnostic interpretation, and the evolving responsibilities and competencies required for nurses in this advanced clinical setting.

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I. INTRODUCTION

In recent years, medical imaging has seen significant progress, particularly in gastroenterology. Capsule endoscopy (CE) has emerged as a valuable, minimally invasive method to visualize the entire gastrointestinal tract [8]. Unlike conventional endoscopy or colonoscopy, CE involves swallowing a small capsule containing a miniature camera that captures thousands of images as it passes naturally through the digestive system [3]. These images provide clinicians with a comprehensive view of areas that were once difficult to assess using standard techniques.

The introduction of Artificial Intelligence (AI) has further enhanced the capabilities of capsule endoscopy. AI-assisted analysis helps detect abnormalities more accurately and efficiently, reducing the time clinicians spend reviewing large sets of images. This advancement has improved diagnostic precision and overall patient outcomes.

Nurses play an essential role in ensuring the success of capsule endoscopy procedures. Their responsibilities span from patient education and preparation to equipment handling, observation during the procedure, and assistance with data analysis. As technology continues to advance, the role of nursing professionals in capsule endoscopy is expanding to include specialized training in device operation, data interpretation, and patient-centered care.

Capsule endoscopy is a modern, noninvasive technique used to visualize the inside of the digestive tract. It is also known as "scopy tablet" [9], in this procedure, the patient swallows a vitamin-sized capsule that contains a miniature wireless camera [2]. As the capsule travels naturally through the gastrointestinal tract, it captures thousands of high-resolution images and transmits them to a recording device worn by the patient [1].



Fig 1: Capsule Endoscopy

II. PROCEDURE OVERVIEW

- The capsule, about the size of a large pill, is swallowed with water. A smooth, slippery coating makes it easy to ingest [4].
- Over the next 8 to 12 hours, the capsule moves through the digestive system by natural muscle contractions [2].
- It takes thousands of color images of the esophagus, stomach, small intestine, and colon [13].
- The images are transmitted wirelessly to a data recorder, usually worn on a belt around the waist.
- After the procedure, the recorder is returned to the doctor, who downloads and reviews the images as a continuous video [7].
- The capsule is disposable and passes naturally in a bowel movement, after which it can be safely flushed away [1].

Capsule endoscopy is a valuable diagnostic tool used to visualize the gastrointestinal (GI) tract, particularly the small intestine. It helps in detecting and monitoring a variety of digestive disorders [6].

➤ Common Diagnostic Applications

- Obscure gastrointestinal (GI) bleeding: Helps identify the source of unexplained or intermittent bleeding that standard endoscopy may miss.
- Inflammatory bowel disease (IBD): Useful in diagnosing and assessing the extent of conditions such as Crohn's disease [12].
- Celiac disease: Enables evaluation of intestinal damage and monitoring of response to dietary treatment.
- Small bowel tumors: Detects benign or malignant growths within the small intestine.
- Inherited polyposis syndromes: Assists in screening for polyps in individuals with genetic predisposition [2].



Fig 2: Capsule Used for Endoscopy

➤ Advantages

- Minimally invasive: The procedure requires no sedation, anesthesia, or air insufflations, making it far less invasive than conventional endoscopy or colonoscopy [6].
- Patient comfort: Most patients find capsule endoscopy more comfortable and less anxiety-inducing, with a quicker recovery and higher overall satisfaction.
- Comprehensive small intestine view: Provides detailed visualization of the small intestine, an area that is often difficult to examine using traditional methods [10].

➤ Limitations

- Diagnostic only: Unlike standard endoscopic procedures, the capsule cannot collect tissue samples (biopsies), remove growths, or perform therapeutic interventions.
- Dependent on bowel preparation: Clear imaging relies on thorough bowel cleansing, as the capsule cannot suction, rinse, or clear obstructions during its passage [8].
- Potential for capsule retention: In rare cases, the capsule may become lodged in a narrowed segment of the intestine, which might require endoscopic or surgical retrieval.

III. CAPSULE ENDOSCOPY AND AI INTEGRATION IN PATIENT CARE

Capsule endoscopy is a medical procedure that allows healthcare providers to examine the gastrointestinal (GI) tract using a small, pill-sized camera [5]. The capsule contains tiny lights that illuminate the digestive system, capturing detailed images as it passes through. This method reduces the need for invasive procedures such as traditional endoscopy [14].



Fig 3: Captured Image and AI Integrated Alert Tags

Although capsule endoscopy became more widely known in the later months of 2020, it became significantly more effective after the integration of Artificial Intelligence (AI). Previously, healthcare professionals had to review thousands of images manually, often spending hours—sometimes overnight—looking for abnormalities. With AI implementation, the process has become more efficient and accurate [5].

AI systems now automatically analyze the captured images, highlighting suspicious areas with red alert tags where abnormalities such as bleeding, ulcers, or other gut pathologies are detected. The AI then generates a summarized report, making diagnosis easier, faster, and more precise. This advancement not only reduces the workload for clinicians but also minimizes the risk of missed findings, ultimately improving patient safety and diagnostic accuracy [10].

With the development of capsule endoscopy, the process has become much simpler and safer. Patients now only need to swallow a small capsule, eliminating the need for inserting large tubes into the digestive tract. This innovation has significantly reduced patient anxiety and discomfort. It has also minimized the workload for nurses, as there is less need for invasive preparation and post-procedure monitoring. Overall, capsule endoscopy, especially with the integration of AI, has made the diagnostic process more patient-friendly, efficient, and accurate.

IV. NURSING RESPONSIBILITIES IN CAPSULE ENDOSCOPY

A. Before the Procedure

➤ Patient Education

Provide the patient with clear information about the purpose, benefits, and potential risks of capsule endoscopy. Explain the procedure steps in detail, including any required dietary restrictions or fasting instructions before the test.

➤ Patient Assessment

Evaluate the patient's ability to understand and follow the given instructions. Perform necessary preliminary assessments and investigations as directed by the physician and record baseline vital signs prior to the procedure.

B. During the Procedure

➤ Equipment Preparation:

Assist the patient in properly wearing the external data receiver. This may involve attaching adhesive sensor patches to the chest and abdomen or positioning a sensor belt around the waist. Ensure that all equipment is functioning correctly before capsule ingestion.

➤ *Capsule Administration:*

Activate the capsule and guide the patient through the swallowing process, ensuring it is taken with sufficient water for comfort and safety [5].

➤ *Patient Observation:*

Monitor the patient for any immediate reactions or discomfort. Provide instructions regarding permissible activities, such as avoiding strenuous physical movement or electromagnetic interference during the recording period [10].

C. After the Procedure

➤ *Data Retrieval*

Transfer the recorded data from the external receiver to a computer system for analysis and archiving. Verify data integrity and completeness.

➤ *Preliminary Video Review*

Qualified nursing staff may conduct an initial review of the captured video, marking areas of interest or potential abnormalities to assist the physician and optimize interpretation time.

➤ *Physician Assistance*

Support the physician by providing a summarized overview of the pre-reviewed findings. Although the final diagnosis remains the physician's responsibility, trained nurses act as valuable clinical partners in the review process [10].

➤ *Documentation*

Ensure that all procedural details, findings, and patient observations are accurately recorded in the endoscopy report or electronic medical record, following institutional protocols.

V. TRAINING AND COMPETENCY DEVELOPMENT FOR NURSES IN CAPSULE ENDOSCOPY

Comprehensive training and proper certification are vital for nurses to perform capsule endoscopy (CE) procedures with the same level of proficiency as qualified endoscopists. Nurses must receive in-depth instruction on the correct operation of the capsule system, including equipment handling, data acquisition, and image interpretation.

Competency assessment should be based on measurable performance indicators such as the number of supervised procedures completed, diagnostic accuracy, adherence to protocol, and overall patient satisfaction. Continuous professional development and periodic evaluations help ensure consistent quality and maintain high standards of clinical practice in capsule endoscopy [9].

➤ *General Instructions*

After consuming the capsule, refrain from eating or drinking for the first two hours. You may begin taking clear fluids after two hours, and a light meal can be taken after four hours[1].

It is recommended to have small, regular meals and to avoid spicy, greasy, or fried foods during this period. You may experience tiredness or low energy for a few days, which will gradually improve as your body adjusts [1].

Ensure your diet includes plenty of fruits, vegetables, fiber, and whole-grain foods to support healthy digestion and recovery.

VI. CONCLUSION

With the development of capsule endoscopy, the process has become much simpler and safer. Patients now only need to swallow a small capsule, eliminating the need for inserting large tubes into the digestive tract. This innovation has significantly reduced patient anxiety and discomfort. It has also minimized the workload for nurses, as there is less need for invasive preparation and post-procedure monitoring. Overall, capsule endoscopy, especially with the integration of AI, has made the diagnostic process more patient-friendly, efficient, and accurate.

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