




## Avicenna's Pioneering Insights into the Ectopic Opening of the Bile Duct into the Stomach: A Historical Perspective

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 <http://doi.org/10.18502/tim.v11i1.21244>

**Received:** 4 Feb 2025

**Revised:** 15 Mar 2025

**Accepted:** 25 Mar 2025

Avicenna (980–1037 AD), a Persian physician and polymath, was one of the most brilliant scholars in the field of medicine. He made transformative contributions to various disciplines, with a particular emphasis on medicine. His medical encyclopedia, *the Canon of Medicine*, stands out as one of the most significant scientific works of the Islamic Golden Age (9<sup>th</sup> to 12<sup>th</sup> century AD). This influential text served as a critical reference for centuries and contained numerous insights that predated modern anatomical and physiological discoveries [1,2]. In addition to incorporating the insights and scientific materials of earlier scholars like Galen, Ahwazi, and Rhazes in his writing, Avicenna produced a work that stood out from previous contributions due to his unique revisions and critical perspective [3]. Although the Canon of Medicine was written over a thousand years ago, many of its insights remain relevant to modern science. For instance, the book provides a detailed description of the various parts of the spine and discusses spinal tumors. Avicenna also mentions catheterization as a treatment for bladder stones and outlines surgical methods for addressing this condition. Furthermore, he presented a surgical technique designed to assist with difficult labor resulting from fetal hydrocephalus [2].

Avicenna possessed a comprehensive understanding of anatomy, particularly concerning the liver. In his Canon of Medicine, he provides detailed descriptions of the hepatic venous system, including the portal vein and its branches. He also makes references to structures akin to what we now recognize as hepatic sinusoids [4]. Additionally, the text contains mentions of the membrane covering the liver, which is known today as Glisson's capsule [5].

In *the Canon of Medicine*, Avicenna described the gallbladder as a sac-like structure located on the convex surface of the liver, adjacent to the stomach, which is characterized as a one-layered structure with three muscular fibers. Furthermore, he discussed the arteries and nerves associated with the gallbladder, providing detailed descriptions of the gallbladder's function, its role in bile storage, and its impact on digestive processes. He noted that bile functions by causing intestinal irritation, aiding in cleaning intestinal surfaces, and promoting stool excretion. Additionally, Avicenna discussed the extrahepatic biliary tract, mentioning the secretion of bile into the duodenum, and accurately described obstructive bile disorders, distinguishing between intrahepatic, gallbladder, and extrahepatic causes of bile obstructions [6]. Intriguingly,

**Citation:** Sadeghi S, Firoozi M. Avicenna's Pioneering Insights into the Ectopic Opening of the Bile Duct into the Stomach: A Historical Perspective. Trad Integr Med 2026;11(1):56-58. <http://doi.org/10.18502/tim.v11i1.21244>

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ingly, he described a type of bile obstruction located in the duct that drains bile into intestine, which is caused by wart-like lesions [7].

In 15<sup>th</sup> part (al-Fan) of the Canon of Medicine, Avicenna discussed anatomical variations in the biliary system, noting that these variations are rare and include the ectopic opening of the bile duct into the gastric antrum (Figure 1). In the 13<sup>th</sup> part, within the chapter (al-Fasl) on gastric diseases, he elaborated on biliary anomalies and described complications arising from bile secretion into the stomach, which can lead to digestive discomfort and, if prolonged, may even result in gastric ulcers [6].

From Avicenna's perspective, the leakage of bile into the stomach can lead to symptoms such as severe thirst, reduced appetite, and digestive disorders. Furthermore, this condition can exacerbate brain-related issues, such as headaches, due to the connection between the stomach and the brain, particularly through their nervous connections [6].

Recent research indicate that ectopic opening of the bile duct into the stomach is a very rare condition, with only a limited number of case reports published. This condition can lead to various gastrointestinal symp-

toms, such as abdominal pain, vomiting, and dyspepsia [8,9]. Nagasawa et al. (2024) documented a case involving a gastric ulcer and hemorrhage attributed to ectopic bile ducts opening into the stomach [8]. This presentation bears a resemblance to descriptions made by Avicenna over a millennium ago.

In medical literature, the ectopic opening of the bile duct into the stomach was first documented by Vesalius in 1543 [10]. This phenomenon is mentioned in the Canon of Medicine, where evidence is provided to explain this rare anatomical anomaly, which has yet to be widely recognized by the scientific community.

The history of biliary anatomy is shaped by the significant contributions of various medical pioneers. While Andreas Vesalius, Samuel Collins and Abraham Vater made groundbreaking discoveries regarding the biliary ducts [11], Avicenna's descriptions of biliary anatomy, especially his acknowledgment of potential variations in the course of the bile duct, have not received the recognition they deserve.

In conclusion, Avicenna's account of rare anomalies in the bile ducts and the connection between the gallbladder and the stomach, particularly his observation of the complications of gastric ulcers arising from these anomalies a thousand years ago, highlights



**Figure 1.** An ancient manuscript of Avicenna's Canon of Medicine, sourced from the Noor Digital Library in Qum, Iran. The section highlighted in the red box illustrates Avicenna's description of the variations in the bile ducts leading to the stomach.

his profound understanding of anatomical intricacies, making his insights relevant even in contemporary discussions.

### Conflict of Interests

None.

### Acknowledgments

This letter was prepared by the authors, who then utilized the language and writing enhancement capabilities of an artificial intelligence called Talk Ai Chat, accessible at <https://talkai.info/chat/>. The text was subsequently reviewed by the authors.

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