ARTIFICIAL INTELLIGENCE FOR THE DIAGNOSIS OF GASTRIC CANCER

The detection of neoplastic gastric lesions, mainly early lesions, may reduce mortality associated with gastric cancer. Artificial Intelligence algorithms today already present a high accuracy in supporting this diagnosis, motivating its integration in systems to support clinical practice in the near future.

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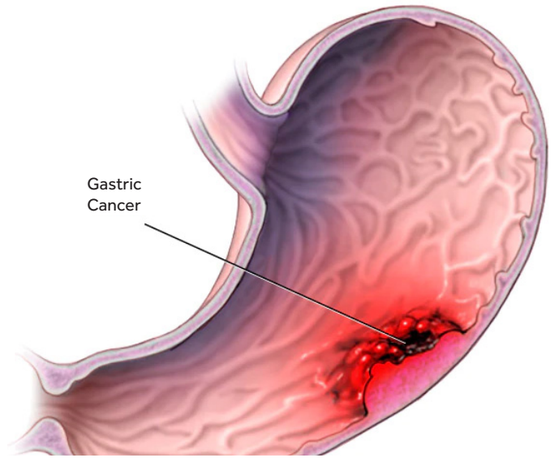


Figure 1 - Gastric Cancer Formation (Adapted from [2]).

Gastric cancer is the third deadliest type of cancer in the world (860,000 deaths in 2017) and in Portugal (2,800 deaths in 2017) [1]. A 20% increase in the incidence and mortality of this type of cancer is expected in 2035, mainly due to demographic effects and late diagnosis. Minimally invasive screening and gastrointestinal endoscopy (GIE) play a key role for an early diagnosis, which is crucial for improving survival rates. However, due to technical and cognitive factors, the risk of diagnostic errors caused by human error is significant, well-illustrated in examples such as Pimenta-Melo [3], a meta-analysis of 22 studies where an error rate of 9.0% is reported in the diagnosis of these lesions. This happens even with the existence of well-defined stomach mapping protocols, such as those of ESGE (European Society of Gastrointestinal Endoscopy) – 10 images – or Japan – 22 images.

Artificial Intelligence, and more specifically Computer Vision, has the potential to mitigate these limitations, especially in two well-defined areas that have been identified as relevant sources of diagnostic errors, and which largely result from the observation and analysis of visual data:

• Detection of gastric reference points – The stomach is a difficult organ to visualize in its fullness. An expert must remotely manipulate a device that illuminates, films, and interacts with a bag-shaped organ, with deformable walls, and with few identifying visual marks. Even for an experienced gastroenterologist, it is not easy to guarantee that 100% of all gastric tissue has been visualized, and it is possible that the lesions to be identified (Figure 2) are precisely in the regions that have not been observed. As reported by Pimenta-Melo [3], this failure rate can reach 9%, which is a very relevant factor for survival rates associated with this disease. What if an artificial intelligence-based system could accurately report to the expert the percentage of gastric tissue visualized during an examination and could guide him to the regions not yet observed?

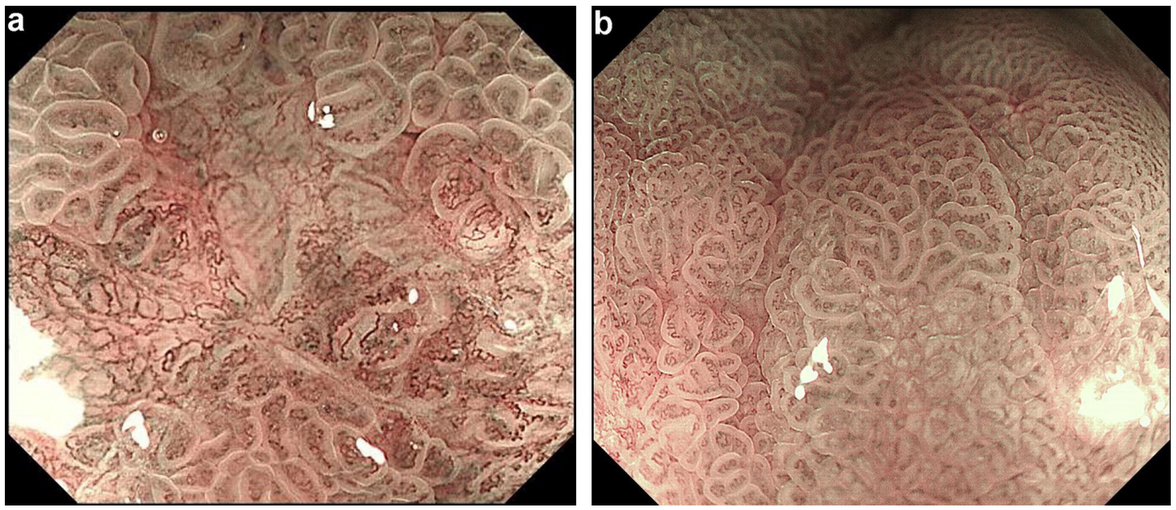
• Detection of gastric cancer lesions – Although upper digestive endoscopy is a standard and well-established procedure, it is possible, as mentioned above, to fail the task of detecting all relevant lesions. As an example, and for physicians still in their learning period, or in regions of the globe where this specialty is not so well developed, we may even think that in the future, systems based on artificial intelligence may enable the optimization of this procedure as it happens for colonoscopy. What if an artificial intelligence-based system allowed the expert to be accurately informed that examined tissues have visual patterns consistent with neoplastic lesions?

To better understand the maturity and current effectiveness of Artificial Intelligence algorithms to support the screening and diagnosis of gastric cancer, an analysis of this state-of-the-art was made via the research of scientific articles indexed by PubMed, EMBASE and Scopus as of July 2020. In this analysis, we included studies that reported the diagnostic accuracy of artificial intelligence algorithms for the detection and characterization of lesions of the upper gastrointestinal tract, including the stomach, taking into account several performance measures. For more details, we refer to the article where this study was published [5].

The results obtained were positive and promising for the future use of these technologies in clinical environments. From an initial query that resulted in 1678 studies found, 19 met all the criteria for a quantitative analysis, showing already very high values of sensitivity (90%) and specificity (89%). In simpler words, approximately 9 out of 10 neoplastic lesions present were correctly detected and identified in all images analyzed by the algorithm, and approximately 9 out of 10 lesions classified as neoplastic by the algorithms were correctly classified. From a more technical perspective, the vast majority of algorithms were based on the latest deep neuronal network structures, with a wide variety of architectures.

Although these results still lack validation in clinical environments, and the problem of the detection of gastric reference points is less developed than that of the presence of gastric cancer lesions, it is unequivocal that the research activity in this field, associated with the very promising results already obtained, outlines a very positive future for the transformative influence that artificial intelligence will most likely have in the screening and management of a growing health problem that is gastric cancer.

Figure 2 - Representative images of lesions of the gastric mucosa, using Narrow-Band Imaging. A) Image diagnosed as gastric cancer; B) image diagnosed as a non-cancerous lesion. (Adapted from [4]).



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