Artificial Intelligence and Anorectal Manometry: automatic detection and differentiation of anorectal motility patterns - a proof of concept study

Miguel Mascarenhas[1,2]; Ilário Froehner[3]; Tiago Ribeiro[1]; João Afonso[1]; Pedro Sousa[4]; Maria Vila Pouca[4]; João Ferreira[4]; Guilherme Macedo[1,2]

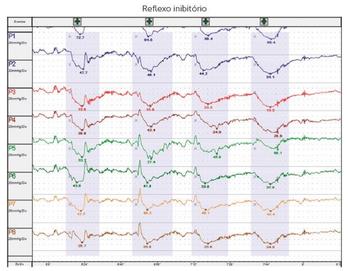
1 – Centro Hospitalar Universitário de São João, Porto, Portugal; 2- Faculdade de Medicina da Universidade do Porto, Porto, Portugal; 3 – Pelvia Gastroenterology Clinic, Curitiba, Brasil; 4 - Faculdade de Engenharia da Universidade do Porto, Porto, Portugal.

Introduction

Anorectal manometry (ARM) has gained increasing relevance in the evaluation and diagnosis of **defecation disorders** and **anal incontinence**, both prevalent in the general population.

Despite its usefulness, ARM **accessibility** is difficulted by the insufficient availability of this exam.

Indeed, the **complexity of data analysis** and the **time required** for its completion and analysis are **significant drawbacks** to its clinical availability.



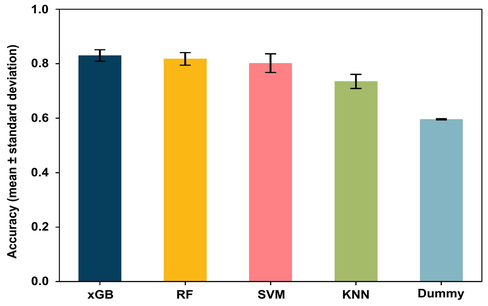
This study aimed to develop and validate a deep learning, artificial intelligence (AI) model to automatically differentiate motility patterns of fecal incontinence (FI) from obstructed defecation (OD), using raw data from ARM.

To date, performance of AI based algorithms for automatic detection and differentiation of different motility patterns in ARM has not been evaluated.

Methods and Materials

Pressure signals were collected from a total of **2469 ARM studies** (including 837 patients with anal incontinence and 1189 with obstructed defecation). Both identification and labeling were performed by **2 expert interpreters** in ARM and included, besides the reference group, patients with **FI and OD**. Before training, all signals were resampled by interpolation or by removal of redundant points.

The **dataset** was then **split** into train and test sets in a **patient-based manner**, for **training and validation** respectively. We normalized the training data to **avoid data leakage.** We then trained and evaluated a deep learning model comprised of **a series of 1D Convolutional Neural Networks (1DCNN) followed by a series of Dense layers.**

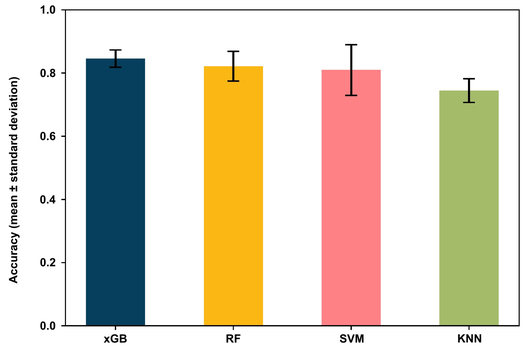


Results

After optimization of the neural architecture, our model presented the following metrics:

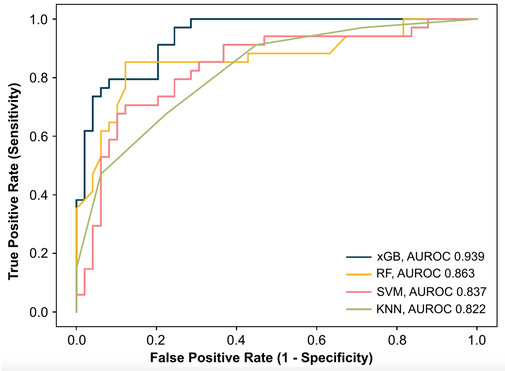
Sensitivity	84.1%
Specificity	80.2%
Precision	78.1%
Overall accuracy	85.7%

Patient-split analyses are an important step toward the real-life implementation of deep learning models, mitigating potential biases of its applicability to a clinical setting.



Discussion

Our group developed a **pioneer AI algorithm** for **automatic detection and differentiation of relevant anorectal motility patterns**. Subsequent development of the CNN as well as **more data** are required to **further develop** the **model's diagnostic performance** and to incorporate additional manometric diagnoses according to the **London classification of anorectal disorders**. Nevertheless, this **proof-of-concept** study highlights the **feasibility** of **AI analysis** in the **interpretation** and **classification** of **ARM** studies. The further development of these tools may **optimize** the **access** to ARM studies, which may have a significant impact on the management of patients with **anorectal functional diseases**.



Contact

Miguel Mascarenhas Saraiva
Centro Hospitalar Universitário São João
Email: miguelmascarenhassaraiva@gmail.com