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Development and validation of a model to predict cessation of antihyperglycemic medication after laparoscopic bariatric surgery among patients with type 2 diabetes

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Abstract

Laparoscopic bariatric surgery (BxS), including sleeve gastrectomy and Roux-en-Y gastric bypass, can lead to remission of type 2 diabetes mellitus (T2DM); however, treatment response to BxS is not homogenous across patients. We used ATLAS and the OHDSI patient-level prediction software to develop a model to predict the probability of complete antihyperglycemic medication cessation (proxy for remission) between 1-2 years after BxS in patients with treated T2DM. The model was trained in the Truven Health MarketScan Commercial Database (CCA) and externally validated in the Optum Extended DOD Database (OPTUM). The target population comprised patients meeting all following criteria: underwent BxS between 2007-01-01 and 2013-10-01 (first=index); aged ≥ 18 at index; continuous observation of 180d before (baseline) to 730d after index; ≥ 1 baseline condition occurrence of T2DM; and ≥ 1 baseline drug exposure for antihyperglycemic medication. The outcome was no drug exposure for antihyperglycemic medication from 365-730 days after BxS. The study included 13,088 and 3,136 patients from CCA and OPTUM, respectively. Antihyperglycemic medication cessation rates were 71.3% and 68.9% for CCA and OPTUM, respectively. The final model possessed good internal discriminative accuracy (area under the curve [AUC]=0.76) and transportability (external AUC=0.74). Further dissemination/evaluation of this model across the OHDSI network is warranted.

Introduction

Laparoscopic bariatric surgery (BxS, also known as ‘metabolic surgery’), including laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB), can lead to significant weight loss and improvements in obesity-related comorbidities among obese persons.¹ In 2016, the American Diabetes Association and other international diabetes organizations published a joint statement in which metabolic surgery was recommended for the treatment type 2 diabetes mellitus (T2DM) in patients with class III obesity (body mass index BMI ≥ 40 kg/m²) and in those with class II obesity (BMI 35.0–39.9 kg/m²) when hyperglycemia is inadequately controlled by lifestyle and optimal medical therapy.² However, treatment response to BxS is not homogenous across patients, and therefore uncertainty remains regarding which specific patients with T2DM may benefit the most among those who are surgically-eligible.

Objective

To develop and validate a model to predict cessation of antihyperglycemic medication after laparoscopic bariatric surgery among patients with T2DM.

Methods

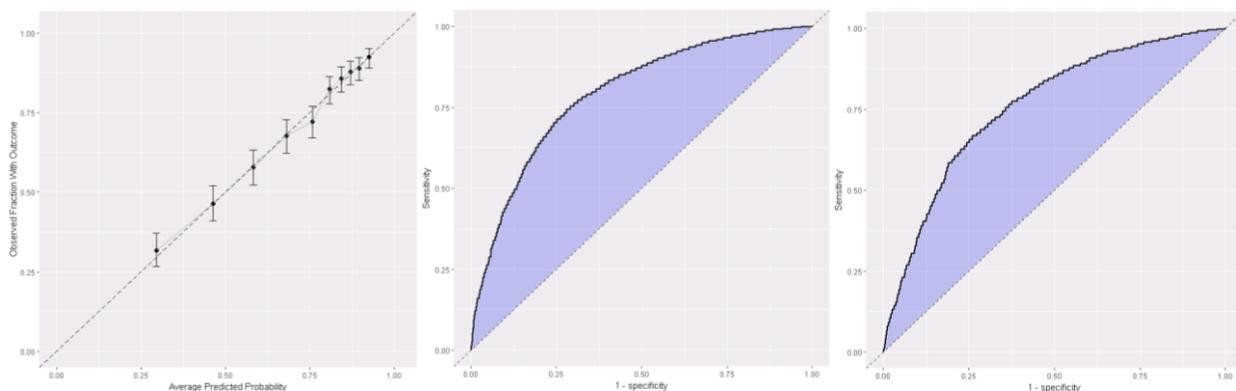
We used ATLAS and the OHDSI patient-level prediction software to develop a model to predict the probability of complete antihyperglycemic medication cessation (as a proxy for T2DM remission) between 1-2 years after BxS in patients with treated T2DM. The model was trained in the Truven Health MarketScan Commercial Database

(CCAIE) and externally validated in the Optum Extended DOD Database (OPTUM). The target population comprised patients meeting all following criteria: underwent BxS between 2007-01-01 and 2013-10-01 (first=index); aged ≥ 18 at index; continuous observation of 180d before (baseline) to 730d after index; ≥ 1 baseline condition occurrence of T2DM; and ≥ 1 baseline drug exposure for antihyperglycemic medication. The outcome was defined as no drug exposure for antihyperglycemic medication from 365-730 days after BxS. A regularized logistic regression model was used to select the ultimate set of model variables from among the following candidates: demographics; baseline Diabetes Complications Severity Index; baseline SNOMED condition occurrences; baseline drug exposures mapped to ingredient level; LRYGB at index (custom concept); LSG at index (custom concept); prior primary adjustable gastric banding (custom concept); prior adjustable gastric banding revision (custom concept); baseline SNOMED measurements and procedures. All baseline variables used the patients' history recorded in the 180 days prior to index (including index date). A 75%/25% split of the CCAIE sample was used for model training/testing; 100% of the OPTUM sample was used for model external validation.

Results

The study included 13,088 and 2,923 patients from CCAIE and OPTUM, respectively. Antihyperglycemic medication cessation rates were 71.3% and 68.9% for CCAIE and OPTUM, respectively. The final model possessed good internal discriminative accuracy (area under the curve [AUC]=0.76 in CCAIE test set with N=3,272) and transportability (external AUC=0.74 in OPTUM external validation set with N= 3,136). Figure 1 displays the CCAIE training set calibration plot and receiver operating characteristic plots for the CCAIE training and test sets.

Figure 1. CCAIE training set calibration plot (left panel) & receiver operating characteristic plots (middle panel: CCAIE, training set; right panel: CCAIE, test set)



Limitations

Cessation of antihyperglycemic medication is not a validated proxy of T2DM remission. Due to potential technological barriers, this model is currently not ideal for use as a clinical decision support tool. The optimal predicted probability threshold for selection of candidates for BxS is unknown and depends on the expected benefits and costs of the procedures within the target population, an area in need of further research.

Conclusion

We developed and externally-validated a model which performed well in the prediction of complete antihyperglycemic medication cessation between 1-2 years after BxS in patients with treated T2DM. Further dissemination, evaluation, and refinement of this model across the ODHSI network is warranted.

References

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