

Analysis of treatment sequences in HER2-positive early breast cancer patients: a retrospective study from the French national hospital database using a Machine Learning algorithm, the TAK

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Objectives

To display an exhaustive and comprehensive overview of the treatment sequences of patients treated for HER2-positive early breast cancer (eBC), using an innovative data-science methodology (the TAK) on the French national hospital database (PMSI).

Methods

PMSI database

It contains information linked to **all hospital stays in France** (medical procedures, costly drugs dispensed) as well as information on the patients (diagnostic codes, demographics).

Main patients inclusion criteria (in the PMSI)

- An hospitalization with a **malignant breast tumor** code and a **breast surgery** in 2016 (60,160 patients)
- Without any codes for metastases** during the follow-up (44,645 patients)
- And with at least one **trastuzumab administration** during the follow-up (3,531 patients)



Cohort definition

- Adjuvant cohort (AC):** 2,619 patients
Patients without any treatment during the neoadjuvant period
- Neoadjuvant cohort (NC):** 912 patients
Patients with at least one treatment during the neoadjuvant period

TAK methodology¹, in 3 steps

- Model** each patient treatment sequence as a timeline



- Algorithmically **arrange** timelines through a similarity criterion (using an Agglomerative Clustering configured with the Hamming distance and the Ward linkage method)



- Smooth** the image to highlight distinctive patterns



How to read the TAK graph?

Each patient starts 6 months before the surgery on the vertical axe at the left of the graph, and moves horizontally to the right, over the course of the 18-month follow-up.



Main limits

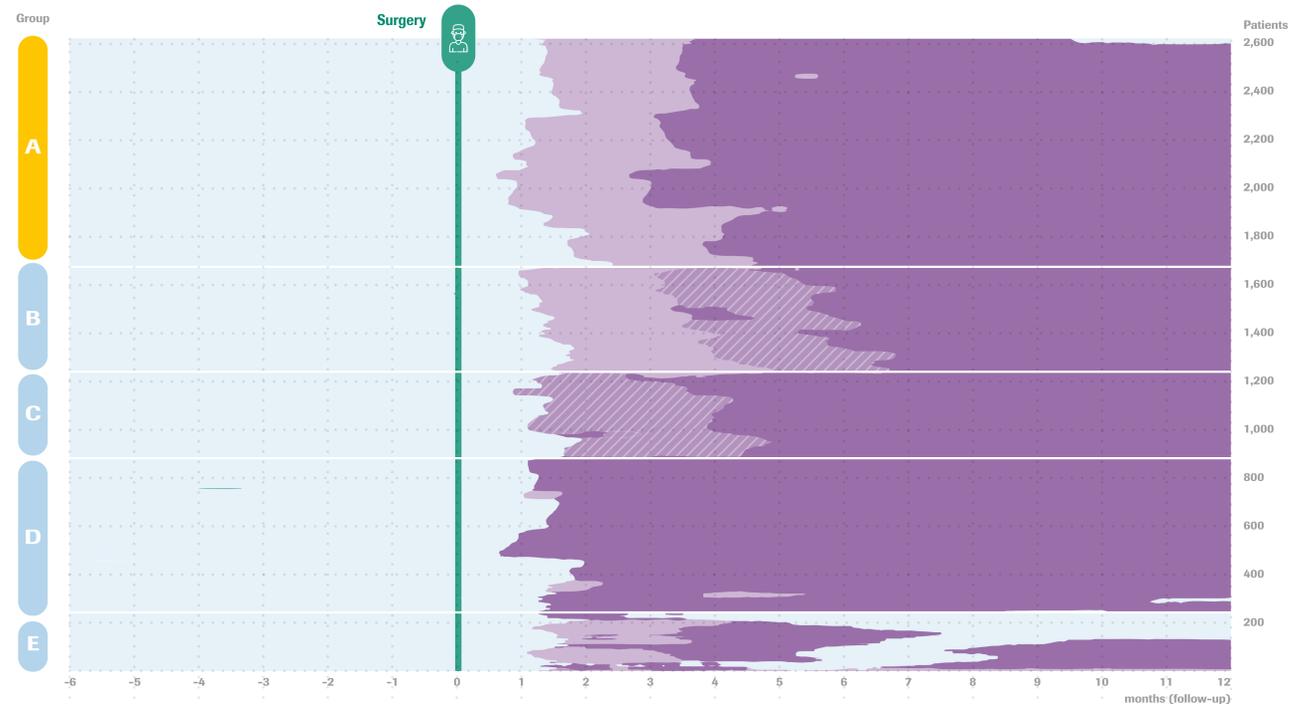
- The PMSI does not include hormone therapy administered outside the hospital, which are usually part of these patients' therapy.
- Metastatic patients are excluded from the cohort, even if metastasis only appear at the end of their follow-up.

Results

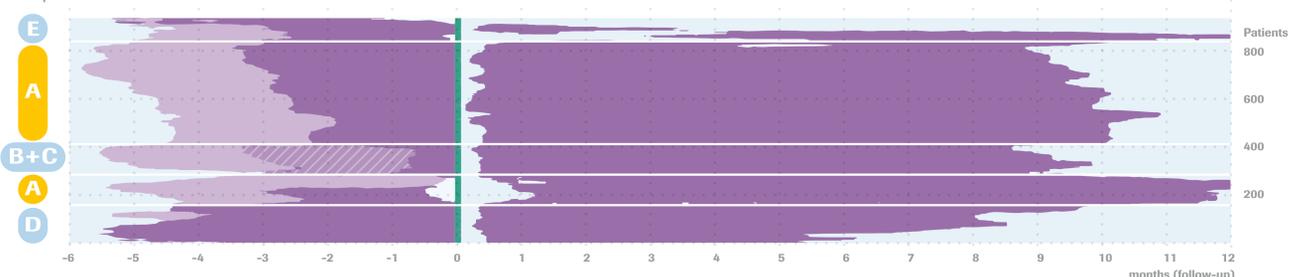
● Chemotherapy ● Trastuzumab ● Combination*
* 21-day treatment cycle combining chemotherapy and trastuzumab

TAK of the treatment sequences

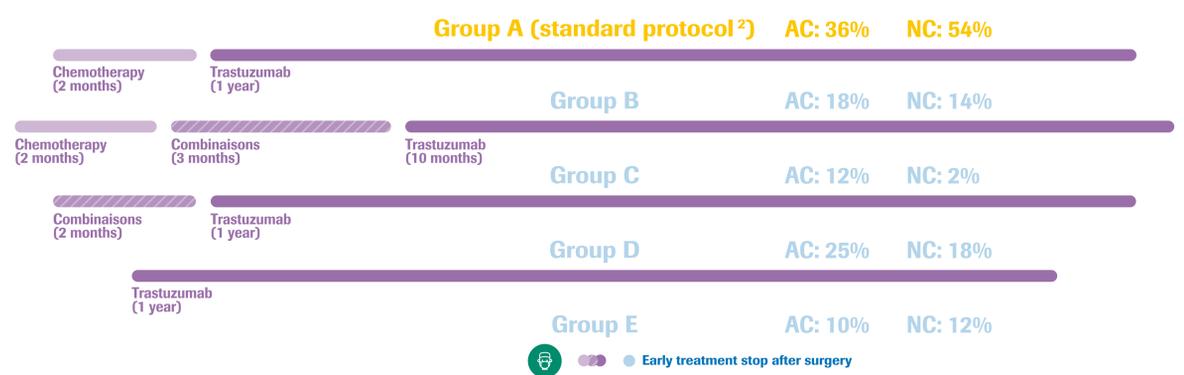
Adjuvant cohort (AC): 2,619 patients



Neoadjuvant cohort (NC): 912 patients



Main treatment sequences patterns (deduced from the TAK)



Conclusion

Methodology

The TAK implements an intelligent visualization combining simultaneously a precise, exhaustive, temporal and easily interpretable overview of the treatment sequences.

Data & RWE

The use of the real-world data (through the PMSI) allows a better understanding of the real-life medical care of these patients. It provides valuable information to the scientific community.

Treatment sequence

The TAK suggests that the management of a large proportion of HER2-positive eBC patients followed the recommendations, but other real-life specific patterns are revealed.

AC: Adjuvant cohort
NC: Neoadjuvant cohort
eBC: early breast cancer

PMSI: Programme de médicalisation des systèmes d'information
RWE: Real-World Evidence
TAK: Time-sequence Analysis through K-clustering

1 H. De Oliveira, A. Batisse, J. Beisel, M. Laurent, M. Prodel. 2020. Meta-TAK: a scalable double-clustering method for treatment sequence visualization.
2 Primary breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. E. Senkus and al on behalf of the ESMO Guidelines Committee, Annals of Oncology, Volume 26, Issue suppl_5, September 2015, Pages v8-v30

