mHealth-supported education improves thromboprophylaxis appropriateness in solid tumors

July 1st, 2024

Methods

Study design

This pre–post intervention study was designed to improve quality of care. The manuscript follows the SQUIRE 2.0 recommendations [15].

Setting

A 290-bed secondary-care hospital within Spain's National Health System.

Participants

Eligible patients were aged 18 years or older and had a recent diagnosis of a solid tumor or disease progression after partial or complete remission. They were starting a new course of systemic anticancer therapy (chemotherapy, targeted therapy, hormone therapy, or immunotherapy) planned for at least 3 months. We excluded patients at high risk of bleeding (e.g., advanced liver disease with coagulopathy), with life expectancy under 3 months, hematologic malignancies, estimated glomerular filtration rate below 30 mL/min/1.73 m^2, platelet count below 50,000/mm^3, body weight below 40 kg, or current anticoagulant use, including full-dose anticoagulation for another indication.

Preintervention period

The investigators reviewed electronic medical records of patients with a recent cancer diagnosis seen between January and June 2024.

Intervention

During the second half of 2024, we held two 60-minute clinical education sessions for physicians in Internal Medicine and Oncology. An internist and an oncologist led reviews of the literature on thrombosis and bleeding risk in patients with cancer, using the latest clinical practice guidelines. The sessions also introduced the TEVAPP software application for subsequent routine use.

TEVAPP is a web-based calculator of VTE risk scores for patients with cancer, developed by SEOM (Spain; https://tevapp.es/; accessed December 15, 2024). It was used to support clinical decisions by integrating available clinical, laboratory, and treatment information at the initial visit before a new systemic regimen. Intermediate-to-high thrombotic risk was defined as a Khorana score of at least 2, corresponding in TEVAPP to 33% of risk factors being present and an estimated 6-month VTE incidence of 8%–10%. High bleeding risk was defined as a score of 3 on the Hokusai scale, corresponding in TEVAPP to 60% of risk factors being present and an estimated 6-month major bleeding incidence of 5.4% [16]. For patients who had been hospitalized, we also used the IMPROVE bleeding risk score; a score of at least 7 indicated a major bleeding risk of 4.1% or a clinically relevant bleeding risk of 7.9% [17].

The treating physician made the final decision about thromboprophylaxis after considering contraindications, bleeding risk, renal function, drug interactions, and patient preferences. Prescriber characteristics were not collected, and use of TEVAPP was not monitored.

Postintervention period

For patients with cancer seen between January and June 2025, the investigators collected the same variables from electronic medical records as in the preintervention period. We selected the same calendar months to control for seasonality and improve comparability.

Variables

Each investigator caring for a patient extracted data using a standardized form. A second investigator checked outlying values; missing values were not imputed. Data included demographics, anthropometric measures, estimated glomerular filtration rate calculated with the CKD-EPI equation, hospitalization in the previous 30 days, tumor site, TEVAPP thrombosis and bleeding risk, ECOG performance status (0–4, with higher scores indicating greater disability), concomitant medications (including erythropoiesis-stimulating agents), pretreatment hemoglobin, platelet and leukocyte counts, and chemotherapy type. Tumor burden was classified into three categories: category 1, no metastases or one metastatic site; category 2, two or three metastatic sites; and category 3, more than three metastatic sites.

Outcomes

The primary outcome was appropriate VTE prophylaxis prescribing from the first medical oncology visit, according to clinical practice guidelines [2,18,19]. Thromboprophylaxis was considered appropriate for patients with intermediate or high thrombotic risk (6-month VTE probability >8%) and low bleeding risk, in the absence of other contraindications. Low bleeding risk was defined as an IMPROVE score <7 for patients hospitalized in the previous 30 days or a Hokusai score <3 for nonhospitalized patients. In the TEVAPP version used, the latter corresponded to fewer than 60% of bleeding risk factors. Withholding thromboprophylaxis was considered appropriate for patients at low thrombotic risk or with contraindications.

Secondary outcomes within 90 days of the first oncology visit were VTE or pulmonary embolism, bleeding, and death. Clinically relevant nonmajor and major bleeding were classified according to the International Society on Thrombosis and Haemostasis definitions [20].

Clinically relevant nonmajor bleeding required non-surgical medical intervention by a health professional and led to hospitalization, a higher level of care, or an unscheduled evaluation. Major bleeding was defined as a hemoglobin decrease of at least 2 g/dL, transfusion of at least 2 units of red cells, bleeding at a critical site, or bleeding contributing to death.

Sample size

Sample size was calculated to compare two independent proportions. The investigators assumed that the frequency of inappropriate thromboprophylaxis prescriptions would decrease from 40% before the intervention to 20% afterward, an absolute difference of 20 percentage points. With a two-sided test, a 0.05 significance level (95% confidence interval), 80% power (β=0.20), and a 1:1 group ratio, 82 patients per group (164 evaluable patients total) were required. Allowing for 10% nonevaluable patients, the target sample was 180 (90 per group).

Statistical analysis

Patient characteristics are summarized as mean and standard deviation or median and interquartile range for continuous variables, and as absolute and relative frequencies for categorical variables. The investigators compared continuous variables between periods using the Student t test or Mann–Whitney U test, as appropriate, and categorical variables using the chi-square test or Fisher exact test when any expected frequency was below 5. We calculated the proportions receiving appropriate thromboprophylaxis and any thromboprophylaxis in each period and thrombotic and bleeding risk category, as well as the proportions experiencing VTE, bleeding, or death within 90 days of study entry. To estimate the effect of study period on 90day thromboembolic (effectiveness model) and bleeding events (safety model), we constructed two multivariable logistic regression models adjusted for confounders identified in bivariate

analyses. Results are reported as adjusted odds ratios (aORs) with 95% confidence intervals. All tests were two-sided, and $p<0.05$ was considered statistically significant. Analyses were performed with SPSS, version 22.