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A Retrospective Analysis of Severe Injury Patients in the Hub and Spoke Centres in the Province of Alessandria

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INTRODUCTION

Trauma is one of the leading causes of death in Western countries and results in severe health, economic, and social consequences due to residual disabilities. To improve the management of major trauma cases, integrated trauma care systems (SIAT) have been implemented in Italy, inspired by North American models. The goal is to centralize severe cases in the most equipped facilities (trauma centers), thereby reducing avoidable mortality [1]. These systems are based on a "Hub and Spoke" network, which includes a Hub center with a Level II Emergency Department (DEA) and several Spoke centers (with Level I DEAs), such as peripheral hospital facilities. In the Province of Alessandria, in Piedmont region, the Hub center is the hospital of Azienda Ospedaliero-Universitaria of Alessandria (AOU AL), and there are four Spoke centers representing the hospitals of the Local Health Authority of Alessandria (ASL AL), located in the cities of Acqui Terme, Casale Monferrato, Novi Ligure, and Tortona. Despite the public health relevance, epidemiological data on trauma in the Italian territory are scarce and inconsistent in the literature.

OBJECTIVE

This study aims to give an epidemiological description of hospitalized severe trauma cases in the Spoke and Hub centers of the Province of Alessandria during the period 2017–2021, also analyzing potential differences between the pre-pandemic and pandemic periods. Additionally, the study aims to assess in-hospital and 30-day mortality for this patient category in both Spoke and Hub centers.

METHODS

Subjects admitted to the Hub and Spoke centers were identified based on hospitalizations (ICD9-CM codes: 800.xx–904.xx; 925.xx–939.xx; 950.xx–959.xx) with discharge dates between 01/01/2017 and 31/12/2021.Trauma severity was assessed using the Injury Severity Score (ISS), based on ICD9-CM codes for principal and secondary diagnosis [2,3,4]: only admissions with ISS >15 (severe trauma) were included. In cases of multiple hospitalizations for the same patient, only the first was considered. Mann-Whitney and Chi-square tests were used to evaluate associations between variables. In order to find determinants of in-hospital and 30-day mortality, Odds Ratios (ORs) with 95% Confidence Interval (95% CI), estimated from multivariate logistic regression models, were used; gender, age, ISS, length of stay, access via Emergency Department, being hospitalized in Intensive Care Unit, being hospitalized during Covid-19 pandemic period (after 01/03/2020) and being hospitalized in Hub/Spoke center were put as covariates. The probability of in-hospital death for each subject was also calculated using the Trauma Mortality Prediction Model (TMPM) [5,6,7]. The predictive capacity of the model was tested on the study sample using ROC (Receiver Operating Characteristic) curves and the corresponding area under the curve (AUC) [8].

RESULTS

In this study, a total of 1,337 patients were included: 705 hospitalized in the Hub center and 632 in the Spoke centers. Most patients in the whole sample were male (59.6%) and the median age was 76 (IQR: 60-85) years. The median length

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of hospital stay was 8 (IQR: 4–14) days, significantly longer in the Hub center: 9 (IQR: 5-16) days in the Hub center, 7 (IQR: 4-12) days in the Spoke center (p<0.001). In-hospital mortality was 10.3% in ASL AL centers and 6.4% in AOU AL (p=0.01). The emergency department was the primary point of access (79.4%) for these hospitalizations. The median ISS was 16 (IQR: 16–22). There were no significant differences in ISS between the hospitalizations during Covid-19 pandemic period and the ones that occurred before (p=0.95), nor in the distribution of in-hospital (p=0.48) and 30-day (p=0.90) deaths. TMPM ROC curves showed an AUC of 0.74 for in-hospital mortality and 0.71 for 30-day mortality. The results of the multivariate logistic regressions indicate that increasing of age (OR=1.08; 95% CI: 1.07–1.10), being male (OR=1.50; 95% CI: 1.06–2.14), higher ISS (OR=1.03; 95% CI: 1.02–1.05), and admission to Intensive Care Unit (OR=3.17; 95% CI: 1.74–5.70) are associated with increased odds of 30-day mortality. Furthermore, increasing of age (OR=1.06; 95% CI: 1.04–1.09), shorter length of hospital stay (OR=0.96; 95% CI: 0.94–0.99), higher ISS (OR=1.02; 95% CI: 1.00–1.03), admission to Intensive Care Unit (OR=5.72; 95% CI: 2.93–11.10), and being hospitalized in Spoke centers (OR=1.74; 95% CI: 1.10–2.80) are associated with increased odds of in-hospital mortality. Being hospitalized during the Covid-19 pandemic period was not significantly associated with increased odds of either in-hospital mortality (OR=0.83; 95% CI: 0.52–1.29) or 30-day mortality (OR=0.96; 95% CI: 0.66–1.37)

CONCLUSIONS

The TMPMs showed good discriminatory power in predicting mortality, supporting their reliability in clinical and operational settings. The absence of statistically significant differences in outcomes between the pre-pandemic and pandemic periods suggests that the Covid-19 pandemic had a limited impact on the care of polytrauma patients. The analysis of in-hospital mortality highlights the need to optimize the management of severely injured patients within the "Hub and Spoke" network. In 2024, the urgent transfer protocol for patients from ASL AL centers to the AOU AL center was revised; a future perspective will therefore be the evaluation of in-hospital mortality in the coming years.

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