Use of a Pediatric Syncope Unit Improves Diagnosis and Lowers Costs: A Hospital-Based Experience

Fabrizio Drago, MD[1], Camilla Calvieri, MD, PhD[1], Silvia Placidi, MD[1], Daniela Righi, MD[1], Simone Paglia, CCP[1], Elisa Del Vecchio, PA, MA[1], Massimo Stefano Silvetti, MD[1], Fabrizio Gimigliano, MD[1], Corrado Di Mambro, MD[1], Marta Unolt, MD[1], Ugo Giordano, MD[2], Umberto Raucci, MD[3], and Massimiliano Raponi, MD[4]

Objectives To assess the effect of a dedicated pediatric syncope unit on the diagnostic and therapeutic management of children with suspected syncope. We also evaluated the effectiveness of the pediatric syncope unit model in decreasing unnecessary tests and hospitalizations, minimizing social costs, and improving diagnostic yield.
Study design This single-center cohort observational, prospective study enrolled 2278 consecutive children referred to Bambino Gesù Children's Hospital from 2012 to 2017. Characteristics of the study population, number and type of admission examinations, and diagnostic findings before the pediatric syncope unit was implemented (2012-2013) and after the pediatric syncope unit was implemented (2014-2015 and 2016-2017) were compared.
Results The proportion of undefined syncope, number of unnecessary diagnostic tests performed, and number of hospital stay days decreased significantly ($P < .0001$), with an overall decrease in costs. A multivariable logistic regression analysis, adjusted for confounding variables (age, sex, number of diagnostic tests), the period after pediatric syncope unit (2016-2017) resulted as the best independent predictor of effectiveness for a defined diagnosis of syncope ($P < .0001$).
Conclusions Pediatric syncope unit organization with fast-tracking access more appropriate diagnostic tests is effective in terms of accuracy of diagnostic yield and reduction of costs. *(J Pediatr 2018;■■:■■-■■).*

Syncope is a common medical problem with an estimated prevalence of 125.8 in 100 000 children,[1,2] 15% in children and adolescents before the age of 18 years,[3,4] with at least 1 fainting episode by 18 years of age in 30%-50% of patients.[2] Overall, syncope accounts for 3% of all admissions to a pediatric emergency department (ED),[1,5] and cardiac evaluation is needed in 3%-5%[6] of cases. The peak incidence is between 15 and 19 years of age and more frequent in females.[1,2] Pediatric syncope episodes are neurally mediated in 75% of cases, followed by psychogenic or unexplained episodes in 8%-15%, but, in a few cases, syncope may be the first sign of cardiovascular problems.[7] In a healthy pediatric population, there is an incidence of sudden cardiac death ranging from less than 1 to 10 deaths per 100 000 population per year.[8]

Currently, the great variation in syncope evaluation and protocols often leads to high healthcare and social care costs, with unnecessary diagnostic tests and hospitalizations.[9,10] Despite American Heart Association/European Society of Cardiologists recommendations[2,11] and evidence from clinical practice,[12,13] syncope unit models are not widely accepted in pediatric practice. A syncope unit is a service with a dedicated staff and a specific diagnostic protocol that can ensure a better management of transient loss of consciousness.[12] Indeed, the aims of diagnostic evaluation in a pediatric syncope unit are to reassure low-risk children, diminish parental anxiety, and identify those high-risk children in whom syncope can be the first sign of cardiac structural diseases and sudden cardiac death.[14] Specific syncope units in the adult population have improved diagnostic and management processes, with a reduction of costs.[13,15-17]

The aim of our study was to assess the effect of a dedicated pediatric syncope unit on the diagnostic and therapeutic management of children with suspected syncope. Moreover, we evaluated the effectiveness of the pediatric syncope unit model in decreasing unnecessary tests and hospitalizations, minimizing social costs, and improving diagnostic yield.

Methods

The functional pediatric syncope unit of Bambino Gesù Children's Hospital was certified at the end of 2013 by peer-review members of GIMSI (*Gruppo Italiano Multidisciplinare per lo studio della Sincope*, www.gimsi.it). This pediatric tertiary referral syncope unit model provides a multidisciplinary approach to children with suspected syncope through evidence-based algorithms similar to models already described for adults.[11,13,16,18,19]

ED	Emergency department
GIMSI	*Gruppo Italiano Multidisciplinare per lo studio della Sincope*

From the [1]Pediatric Cardiology and Cardiac Arrhythmias-Syncope Complex Unit, Department of Pediatric Cardiology and Cardiac Surgery; [2]Sports Medicine Unit, Department of Pediatric Cardiology and Cardiac Surgery; [3]Emergency Department; and [4]Clinical Care and Management, Innovation Research Area, Bambino Gesù Children's Hospital and Research Institute, Rome, Italy

The authors declare no conflicts of interest.

https://doi.org10.1016/j.jpeds.2018.05.032

FLA 5.5.0 DTD ■ YMPD10017_proof ■ June 28, 2018

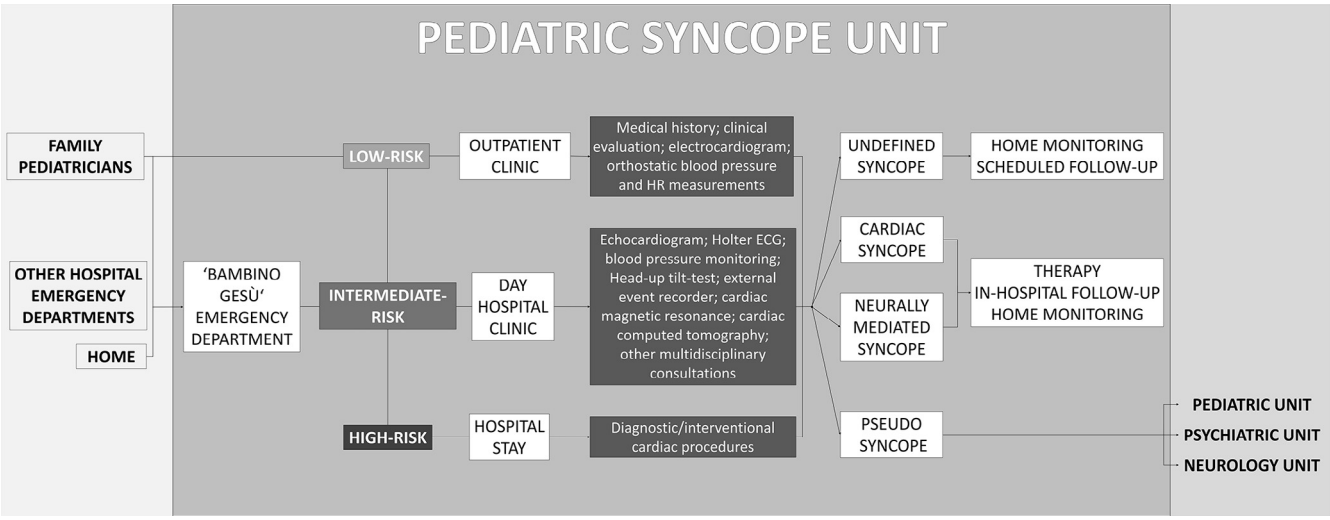

Figure 1. Flowchart of diagnostic-therapeutic pathways in the pediatric syncope unit. *HR*, heart rate.

Based on GIMSI certification requirements (**Table I**; available at www.jpeds.com), our pediatric cardiology and cardiac arrhythmias unit applied the specific organization described in detail in **Figure 1**. The Bambino Gesù Children's Hospital pediatric syncope unit staff is composed according to the standards proposed by the European Society of Cardiologists European Society of Cardiologists-European Heart Rhythm Association-Heart Rhythm Society (pediatric cardiologists, interventional pediatric cardiologists, electrophysiologists, and pediatricians).[11,12,20] A patient's first evaluation is accomplished by a pediatric cardiologist, who collects medical and familiar history according to a dedicated checklist (**Appendix 1**; available at www.jpeds.com), before performing a physical examination and an electrocardiogram. After this first evaluation, patients are referred to the pediatric syncope unit based on guidelines classification[19,21]: high-risk children are hospitalized, intermediate-risk children are sent to the day hospital clinic, and low-risk children are sent to the outpatient clinic. Family pediatricians are allowed to schedule a pediatric syncope unit outpatient clinic appointment after their own evaluation.

This a single-center prospective, observational, cohort study. The Bambino Gesù Children's Hospital Institutional Ethics Committee approved the study and all parents provided written informed consent.

Syncope was defined as a transient loss of consciousness owing to momentary global cerebral hypoperfusion, characterized by a rapid onset, with or without prodromal symptoms, and short duration, and followed by spontaneous complete and rapid recovery.[2,11] Syncope was classified in 3 categories: neurally mediated syncope, cardiac syncope, and undefined syncope. Breath holding spells in patients less than 4 years of age were classified as neurally mediated syncope. Exclusion criteria for data collection were pseudosyncope secondary to a different disease (ie, hypoglycemia) or diagnosis of cerebral involvement (epilepsy, stroke, transient ischemic attack, meningoencephalitis, and traumatic brain injury). In patients with intermediate-risk and high-risk syncope, pseudosyncope, or persistently undefined syncope, a dedicated team performed multidisciplinary evaluations (psychologist, endocrinologists, nutritionists, gastroenterologists, and neurologists). Psychological assessment was performed in all patients with neurally mediated syncope and pseudosyncope.

Follow-up was continued for all patients after diagnosis and treatment. When a neurally mediated syncope was diagnosed, educational material was distributed to patients and family (**Appendix 2**; available at www.jpeds.com). Data collected for each patient enrolled included age, sex, number and type of diagnostic tests, number of day hospital accesses, hospital and ED durations of stay, time passed between the ED and the cardiac evaluation, neurologic consultations in ED, patients directly discharged by the ED, and final diagnosis.

To assess the impact of the implementation of a pediatric syncope unit in our hospital, we compared the overall results of 3 periods, lasting 2 years each: the period before the pediatric syncope unit was implemented (2012-2013), immediately after the pediatric syncope unit was implemented (2014-2015), and late after the pediatric syncope unit was implemented (2016-2017). In addition, according to the results of the specific diagnostic tests, we compared 2 periods: before the pediatric syncope unit was implemented (2012-2013) and after the pediatric syncope unit was implemented (2014-2017).

Informed consent was obtained from each patient and the study conformed with the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

Statistical Analyses

Categorical variables were reported as counts (percentage) and compared with the χ^2 test for multiple comparisons or the Fisher exact test. Continuous variables were first tested for Gaussian distribution with the 1-sample Kolmogorov-Smirnov test, then were expressed as mean ± SD, and compared with 1-way

FLA 5.5.0 DTD ■ YMPD10017_proof ■ June 28, 2018