EnSite™ Precision-3D Cardiac Mapping System

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Abctract

Impact of medical technologies and its use in electrophysiology was shown in this paper. New launched EnSite™ Precision (St. Jude Medical) three-dimensional cardiac mapping system was introduced. The rule of 3D model heart creation based on impedance changes and beneficial combination with magnetic field was described such as new automated features developed in order to cardiac map preparation and lesion presentation.
Development of medical technologies positively impacts on procedures performance what is especially noticeable in cardiology. Three-dimensional cardiac mapping systems used during ablations significantly influence on fluoroscopy reduction, opportunity of complex arrhythmias termination and decrease of procedure time duration. Launched in 2016 EnSite™ Precision (St. Jude Medical) with its new features (combination of impedance and magnetic field, AutoMap, Automark) is a complex tool that can be used during performing ablation procedures.

Key words:

ablation, 3D cardiac mapping system, EnSite, EnSite Precision

Introduction

Over last two decades, the field of cardiac electrophysiology (EP) has undergone tremendous evolution [1-2]. Undoubtedly, one of the most impressive changes has been noticed in procedures called catheter radio frequency (RF) ablations, operations that aim at destroying abnormal heart tissues responsible for the arrhythmia using flexible catheter advanced through the vein or artery and placed into the heart. RF energy delivered through the catheter heats up the cardiac tissue at the tip of the catheter destroys tissues that are capable of triggering or sustaining arrhythmia [3]. Electrophysiology procedures, including catheter ablation, are traditionally performed under fluoroscopy in order to guide in placement and navigation of catheters. Orientating the operator the exact location of the catheters is paramount in any given invasive procedure [4-7]. The radiation exposure during electrophysiology procedures is non-negligible for both patients and laboratory staff [8-12]. The relation between radiation dose from medical imaging and the attribute life time risk of cancer and genetic abnormally stresses in cardiac EP practice [13-15]. The information provided by fluoroscopy is limited since it is a 2D display of a complex 3D situation.

Three-dimensional (3D) mapping systems were first introduced in the late 1990s to aid in complex ablation procedures to guide the ablation strategy and to allow electrophysiologist to target more challenging arrhythmias by offering activation/voltage data and visualization of the catheters and of the created lesions in 3D views and further helped to reduce fluoroscopy exposure showing that catheter ablation through a minimally fluoroscopic approach is feasible and safe [16-18]. The relation between radiation dose from medical imaging and the attribute life time risk of cancer and genetic abnormally stresses the importance of minimization of X-ray exposure in cardiac EP practice [19]. Using 3D mapping systems, a virtual 3D map is created of any given cardiac chamber and ideally the catheters can be navigated without the need of fluoroscopy [5-6]. Their use has certainly allowed better understanding and ablating complex arrhythmias [20-22].

Not only fluoroscopy reduction and 3D heart model creation influence on the usefulness of mapping systems. These systems are truly helpful with terminating complex arrhythmias using local activation or voltage maps [23-24].

EnSite™ Precision – New Features

In 2016, the new version of one of the most popular mapping systems, called EnSite Precision™ Cardiac Mapping System (St. Jude Medical), was introduced on the market. As the previous version (EnSite NavX™ Cardiac Mapping System, St. Jude Medical) EnSite Precision™ relies on three pairs of nominally orthogonal skin patches in x-y and z axis positioned on the patients' back, chest and left leg. These patches create an electrical location of field on the patients' thorax. An additional positioned on the abdomen serves as reference during advancement of the catheters in iliofemoral venous axis (Fig. 1). The system collects electrical data from standard electrophysiology catheters and uses this information to track or navigate their movement, construct 3D model of the chamber and create activation (Fig. 2) and voltage map (Fig. 3) [2].

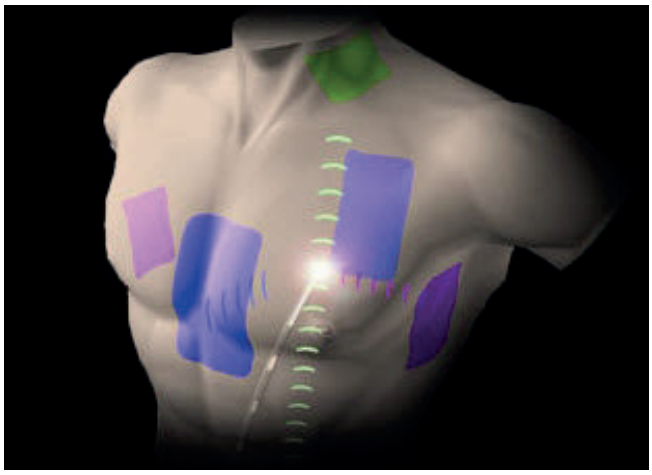

Fig. 1.
Schematic principle of 3D model creation using EnSite™ cardiac mapping system [25]

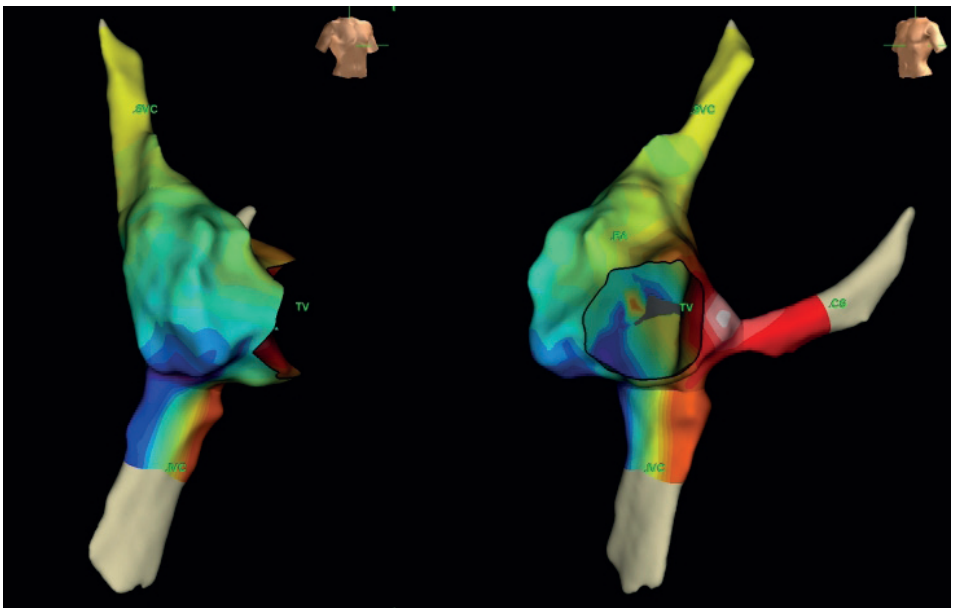

Fig. 2.
Example of local activation map of the right atrium

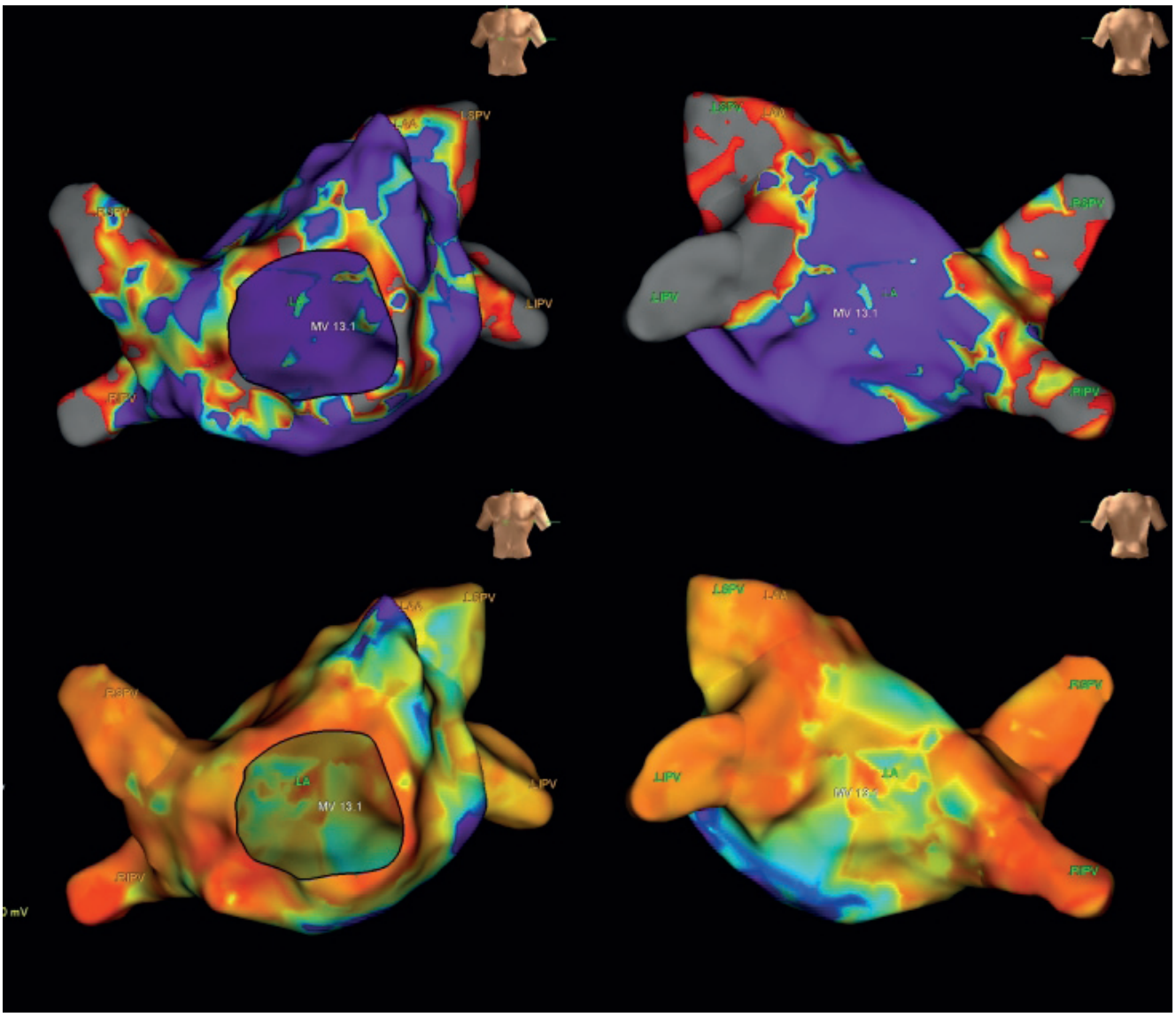

Fig. 3.
Examples of voltage maps of the left atrium (bipolar – top panel, unipolar – bottom panel)

Moreover, in order to increase map stability, enhance navigation and model creation, impedance field is combined with magnetic (Fig. 4). This requires additional source of magnetic field and special sensors which are placed on the patient (one on the back and the other on the chest of the patient). Furthermore, two types of catheters – diagnostic Advisor™ FL Circular Mapping Catheter, Sensor Enabled™ (St. Jude Medical) and ablation – FlexAbility™ Ablation Catheter, Sensor Enabled™ (St. Jude Medical), with embedded sensors, were designed in order to "collect" magnetic points. The geometry preparation is still based on impedance field created by the EnSite™ NavX surface electrodes what ensure system capability of visualizing of all catheters and use of all catheters for data collection.

Another useful tool is called EnSite™ Automap Module (St. Jude Medical) which allows creating no point limit high density maps (27 higher resolutions) in less time in comparison to the previous version [26-27]. Geometry and desired maps can be simultaneously created based on defined criteria: signals morphology, cycle length, catheter movement velocity, signal-to- noise ratio, catheter distance between previously acquired point and catheter contact force. EnSite™ Automap Module is compatible with all catheters- no need the Sensor Enabled™ catheter. New designed

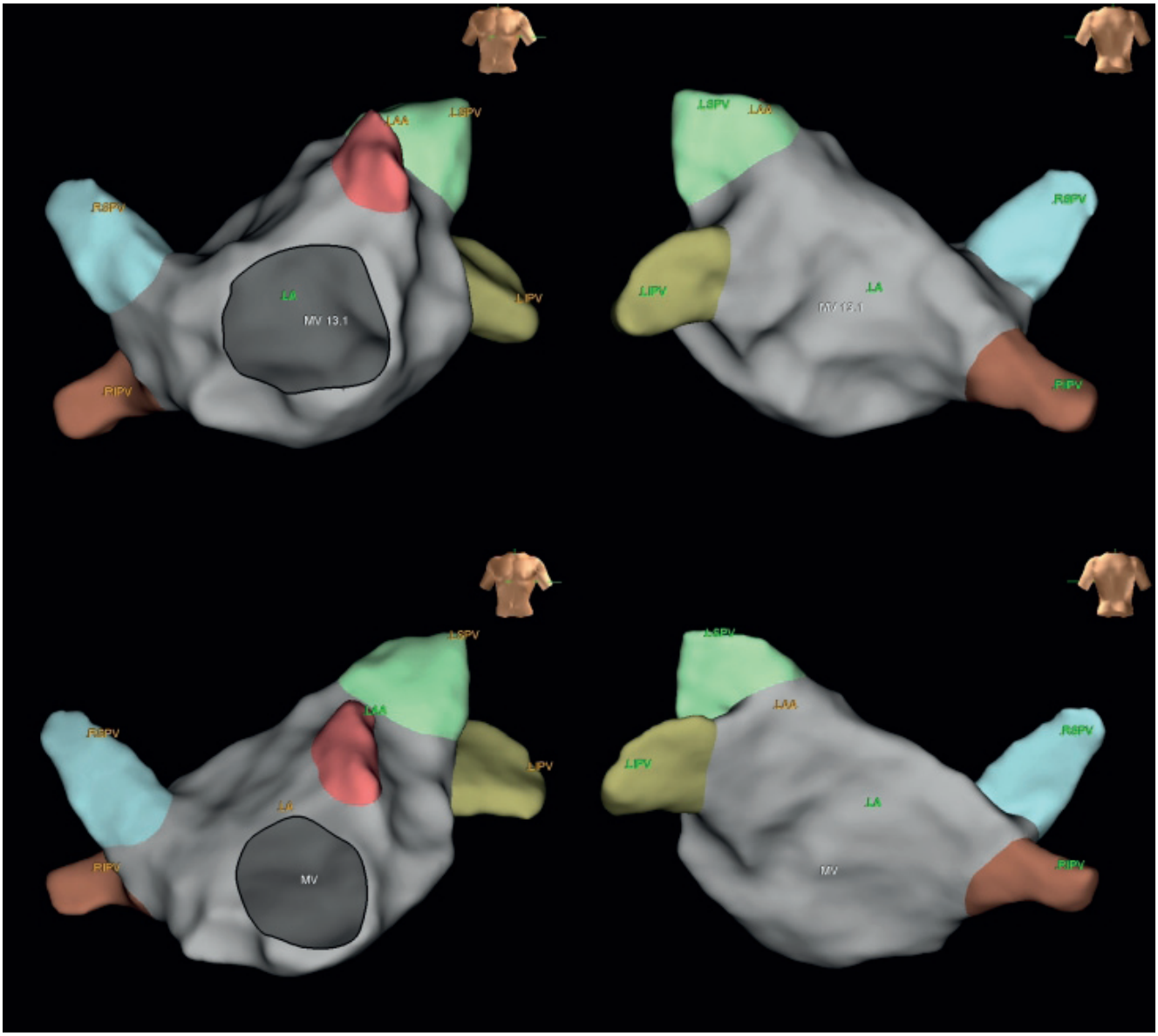

Fig. 4.
3D heart model created via EnSite™ NavX (top panel) and EnSite™ Precision (bottom panel)

Fractionation Map function allows defining the placement of fractionated potentials what can be useful during e.g. VTs termination. Unique features of the TurboMap significantly reduce mapping time- once recorded map can be liberally adjusted and modified with no need to recollect new points.

EnSite™ Automark Module (St. Jude Medical) refers to automated lesion creating tool. Only lesions meeting user-defined requirements are placed on the map. The ablation points can be displayed based on chosen criteria: FTI, average force, maximum force (only for TactiCath™ Contact Force Catheter), energy, time, impedance drop, impedance drop (%), average power, maximum power, average temperature, maximum temperature. EnSite™ Automark Module requires Ampere™ RF Generator (St. Jude Medical). Various ablation parameters (LSI, FTI, average force, maximum force, energy, time, impedance drop, impedance drop (%), average power, maximum power, average temperature, maximum temperature, RF session time, power, temperature, impedance, current) can be displayed on the screen as a numeric value and also in thee graphic form, what provides useful information (Fig. 5). Additional Autotrack™ tool automatically records precise tip location during RF energy application which helps to identify potential gaps by viewing specific lesions (Fig. 6).

Conclusions

As has been shown, development of medical technologies, especially in cardiology, brings significant benefits. Procedures are faster, safer, more effective, with less complications and use of the 3D cardiac mapping system allows on terminating very complex arrhythmias what was impossible in the past (even pregnant women). EnSite™ Precision with its new features efficiently influences on ablation process.

Conflict of interest

The authors declare that they have no conflict of interest.

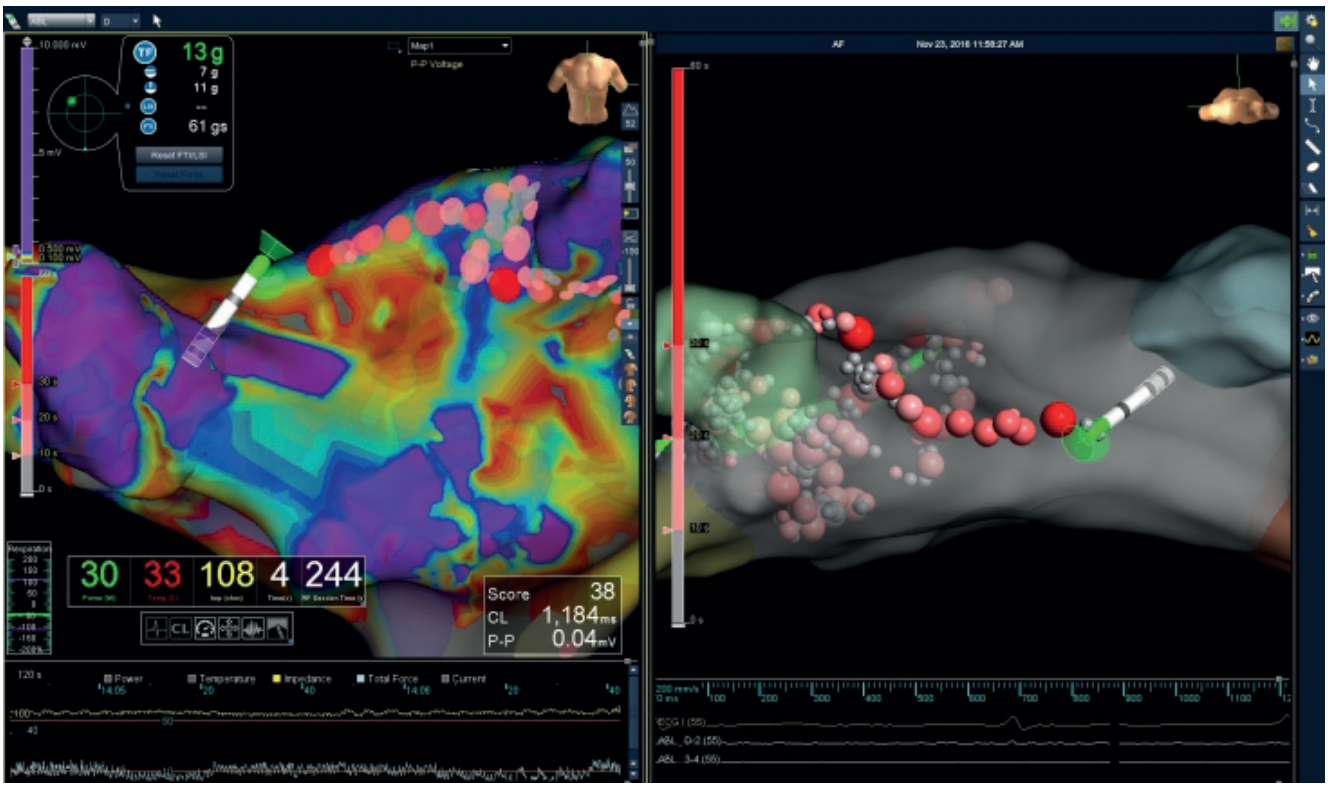

Fig. 5.
EnSite™ Precision during performing atrial fibrillation ablation

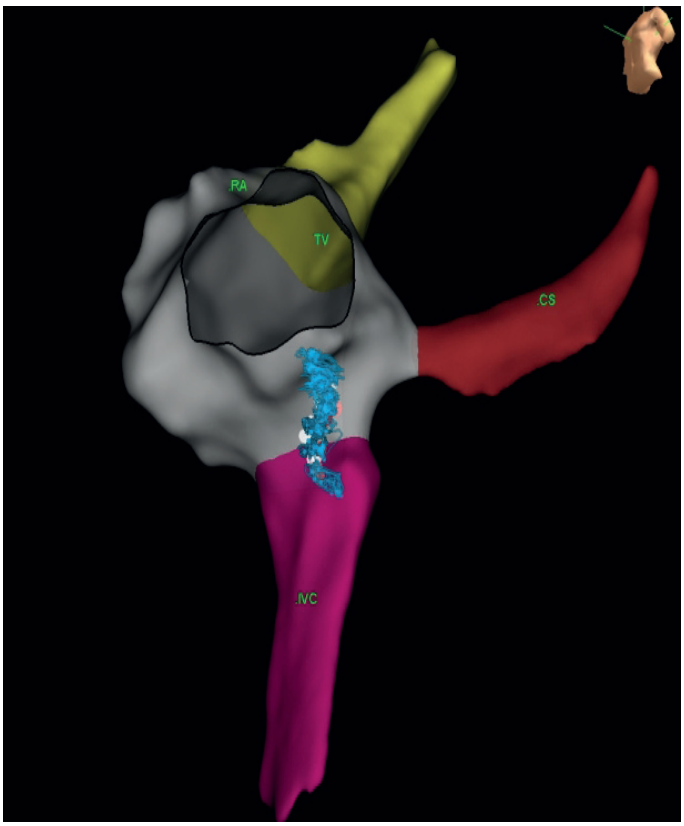

Fig. 6.
Example of Autotrack™ tool. RA, right atrium; TV, tricuspid valve; CS, coronary sinus; IVC, inferior vena cava

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