Complete Right Bundle Branch Block, Left Anterior fascicular block associated in the sitting of Acute ST-Segment Elevation Myocardial Infarction

Bloqueio completo do ramo direito, bloqueio fascicular anterior esquerdo no contexto de infarto agudo do miocárdio com elevação do segmento ST

Bloqueo Completo de Rama Derecha, Bloqueo Fascicular Anterior Izquierdo asociado a Infarto Agudo de Miocardio con Elevación del ST

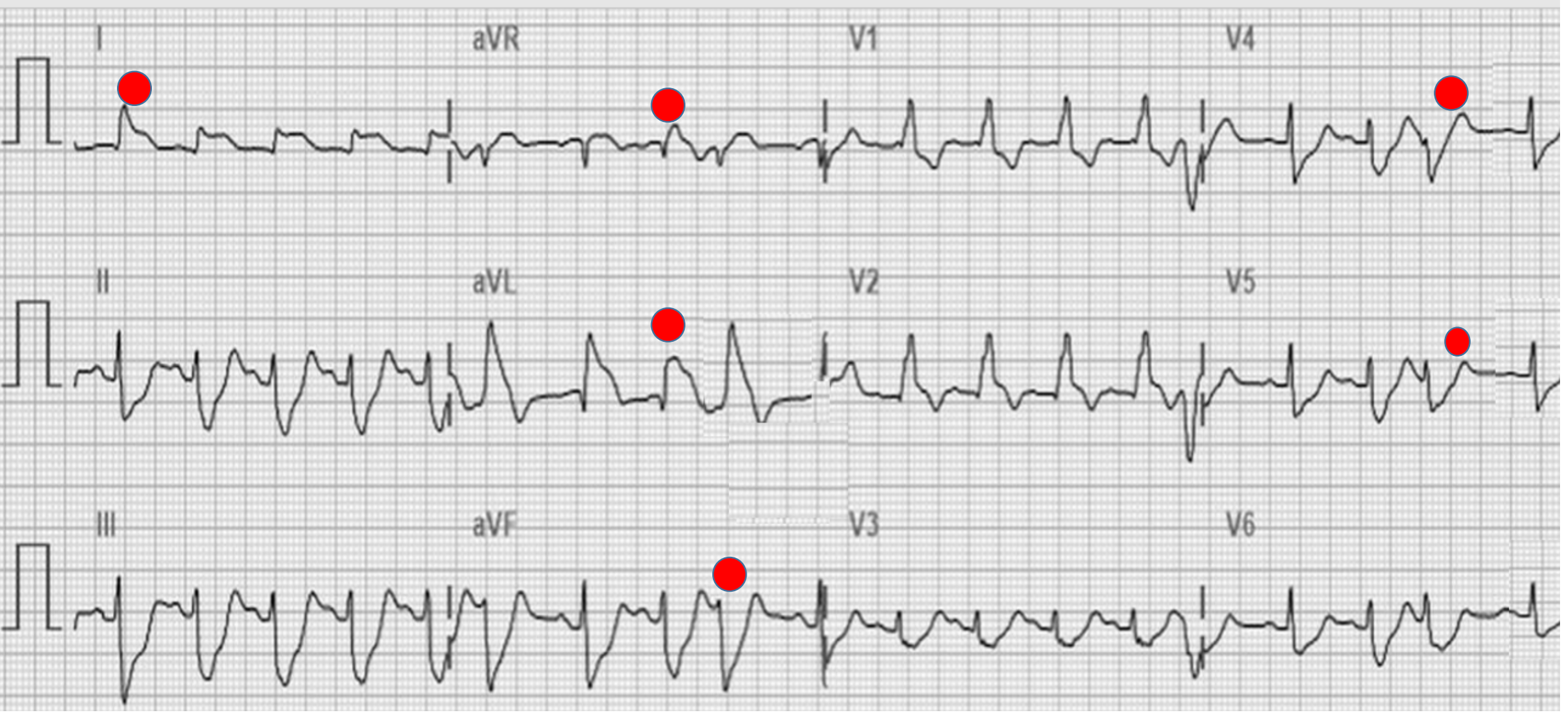
Final comments by Andrés Ricardo Pérez-Riera

Case report

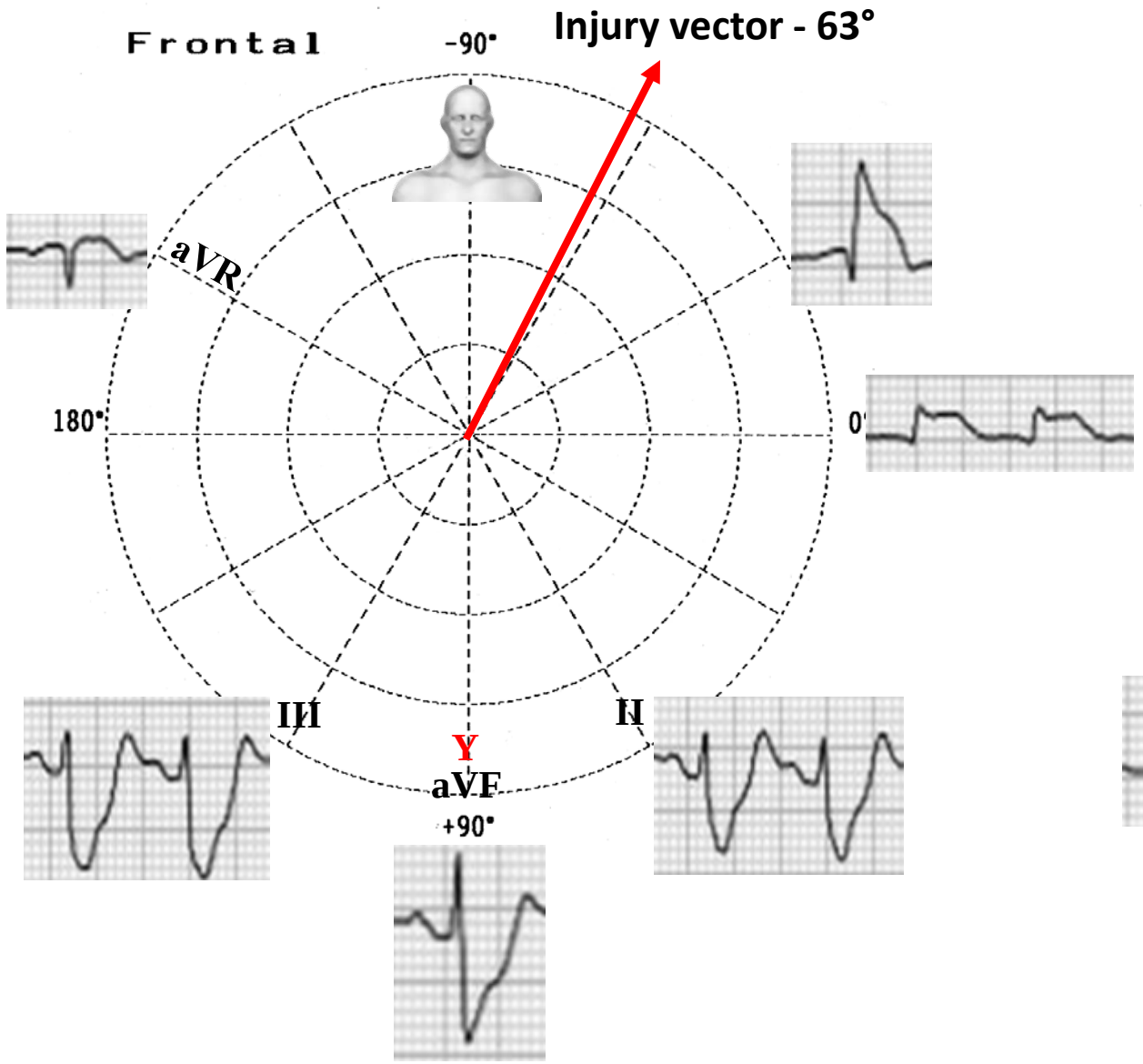
This 59-year-old woman with a history of type 2 diabetes mellitus, dyslipidemia, and hypertension presented to emergent department with resting onset oppressive chest pain radiated to the jaw, sudden dyspnea at rest, profuse cold diaphoresis. blood pressure 90-55mmHg. (**Admission ECG figure 1**).

Under the diagnosis of acute myocardial infarction (AMI) with cardiogenic shock, emergent cardiac catheterization was preformed and showed left main coronary artery (LMCA) acute total occlusion (ATO) (**figure 2**). Her ECG pattern recovered after timely revascularization (figure 3), but low cardiac output signs with multiple organ hypo perfusion still happened. Intra-aortic balloon pump was placed for mechanical support, and inotropic agent was administrated. Her general condition improved gradually after mechanical support, and she was discharged uneventfully 7 days after the event (figure 4).

Figure 1; Admission 12-leads ECG



Admission 12-leads ECG showed sinus tachycardia, right bundle branch block (RBBB), left anterior fascicular block (LAFB) ST Segment elevation in I-aVL and diffuse ST-segment depression (8 leads), and premature supraventricular contractions


Frontal
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Injury vector - 63°
aVR
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aVF
+90°

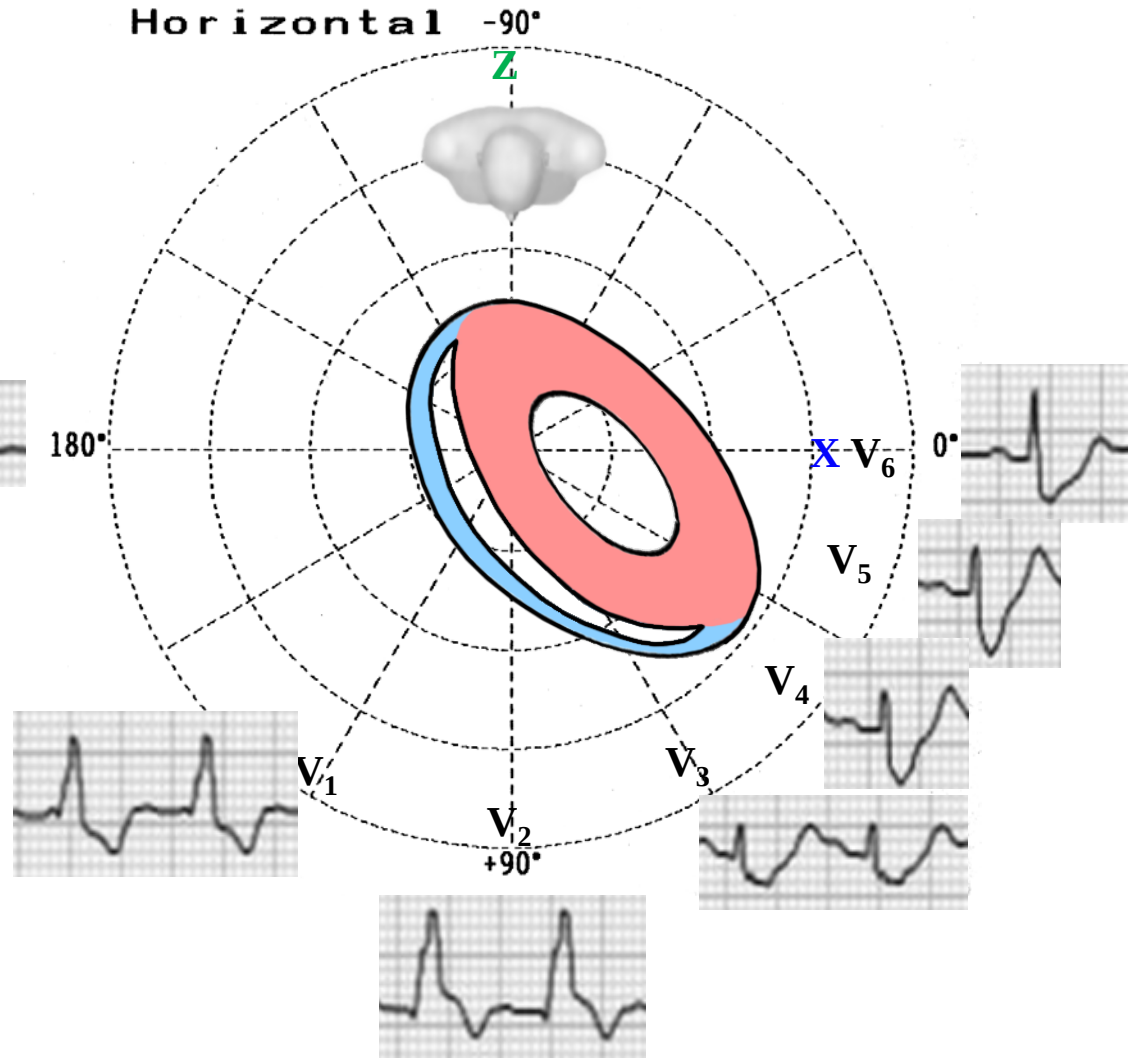
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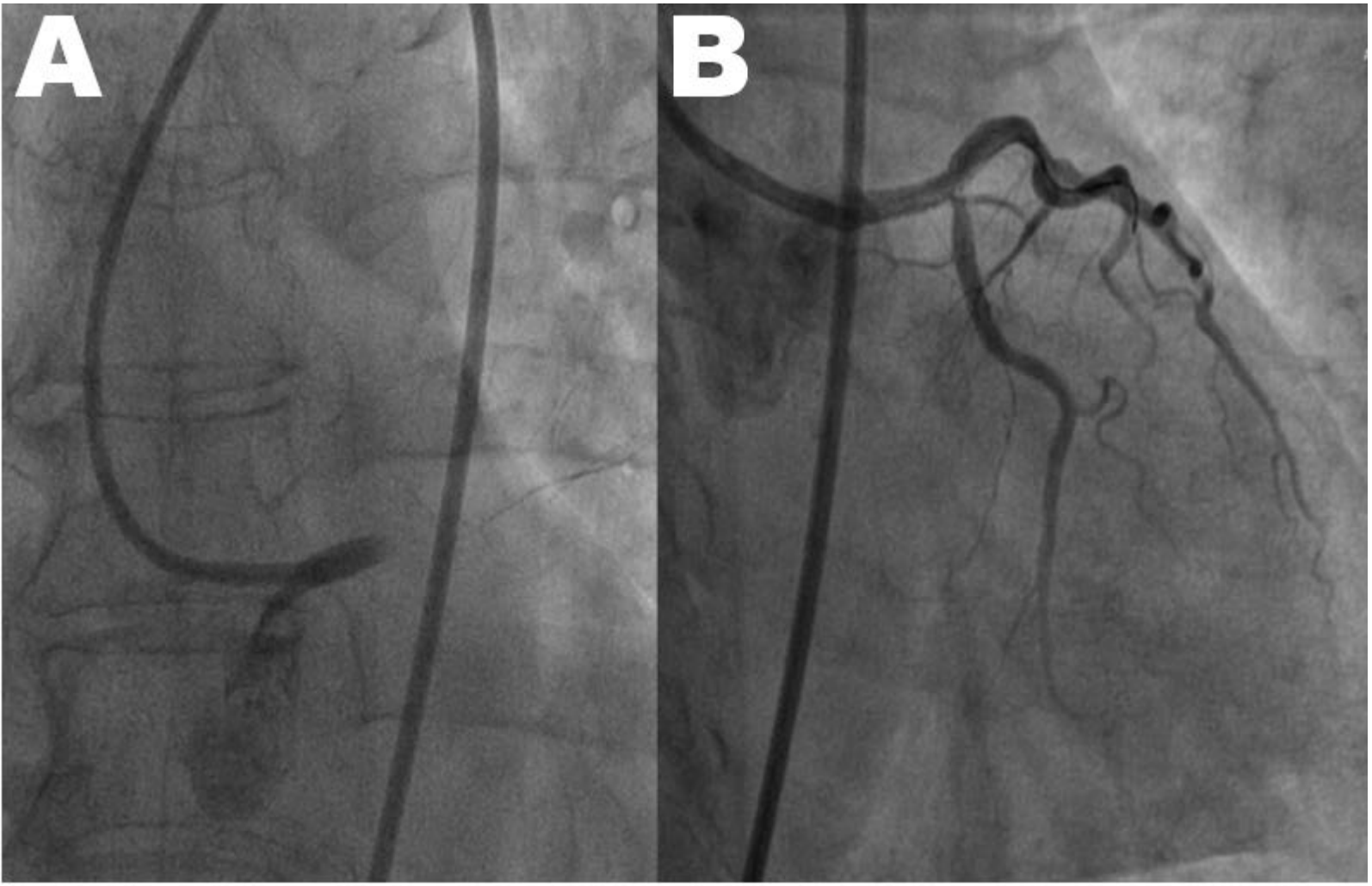
Figure 2

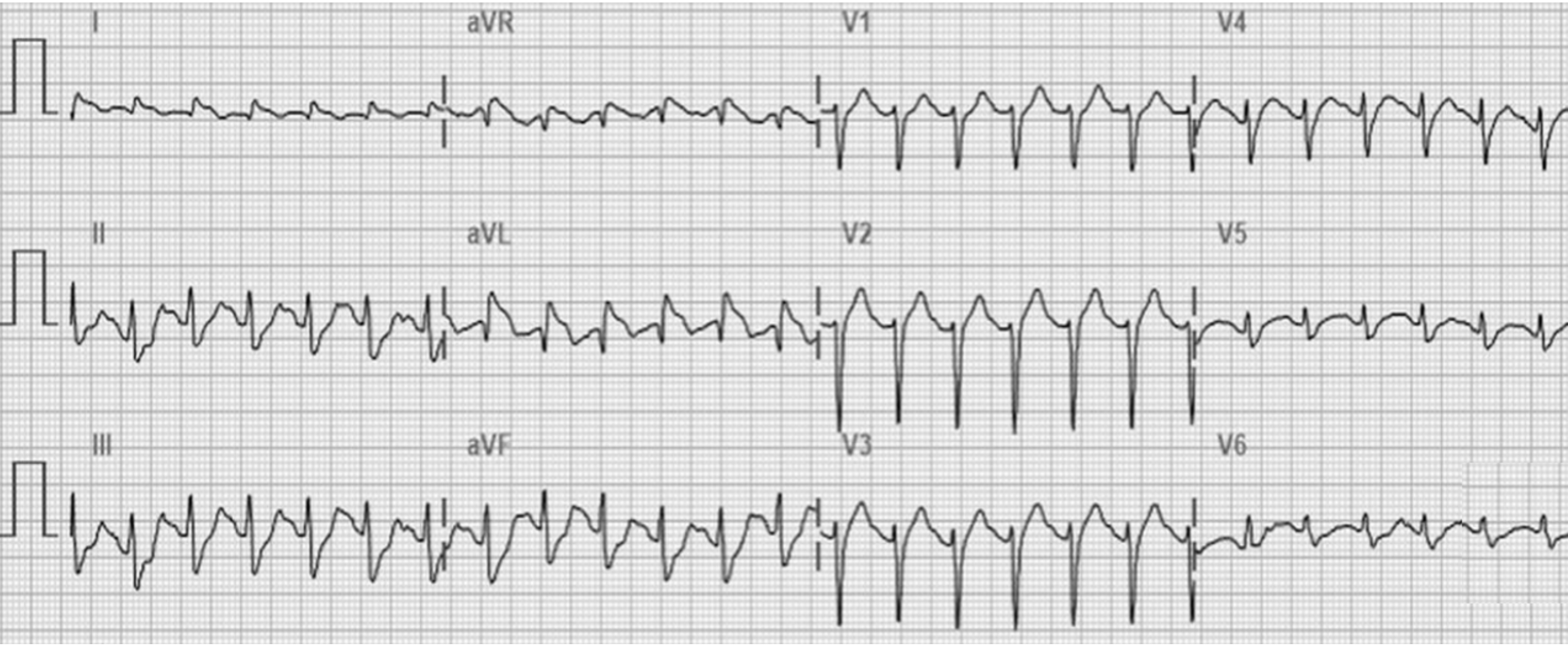


An ATO was defined as follows:

1. A duration of the occlusion of <1 week, as determined from a previous angiogram, the date of a previous myocardial infarction, or the onset of symptoms; and
2. A Thrombolysis In Myocardial Infarction coronary flow grade 0 or 1. The TIMI (Thrombolysis in Myocardial Infarction) flow grade is a widely used method for the assessment of coronary artery flow in acute coronary syndromes. Flow in coronary arteries is classified as **grade 0 (no flow), grade 1 (penetration without perfusion)**, **grade 2 (partial perfusion) or grade 3 (complete perfusion)**

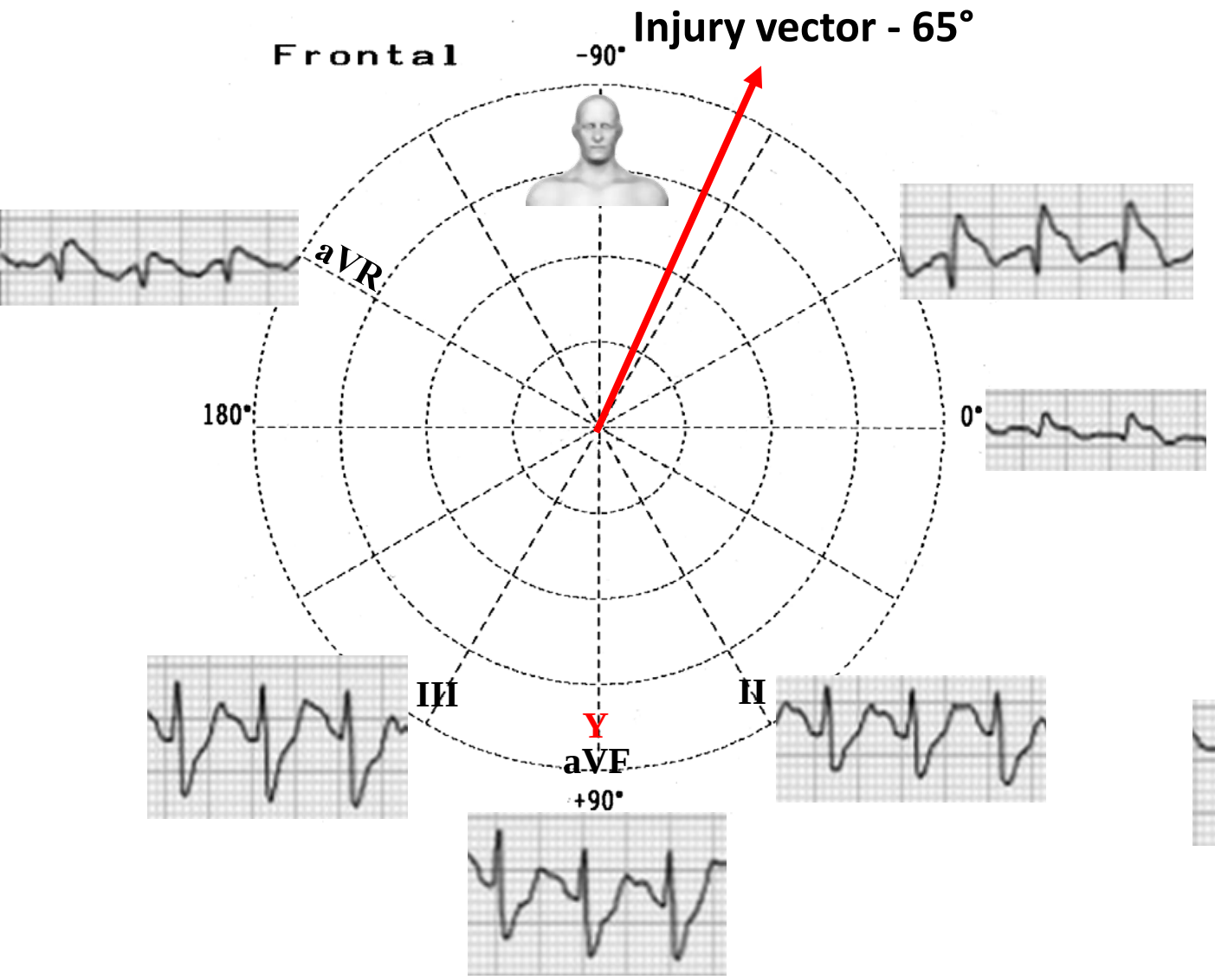
(A) Initial coronary angiography showed total occlusion of left main coronary artery (LMCA): Acute Total coronary Occlusion (ATO) .
(B) Final image after stent deployment at LMCA to left anterior descending artery.

Figure 3



ECG preformed immediately after Percutaneous Coronary Intervention (PCI):

Sinus tachycardia (HR=150bpm) ST depression in the inferior leads, and V_5-V_6 and STE: I, aVR, aVL (STE aVL> aVR: Injury vector on left superior quadrant - 65°).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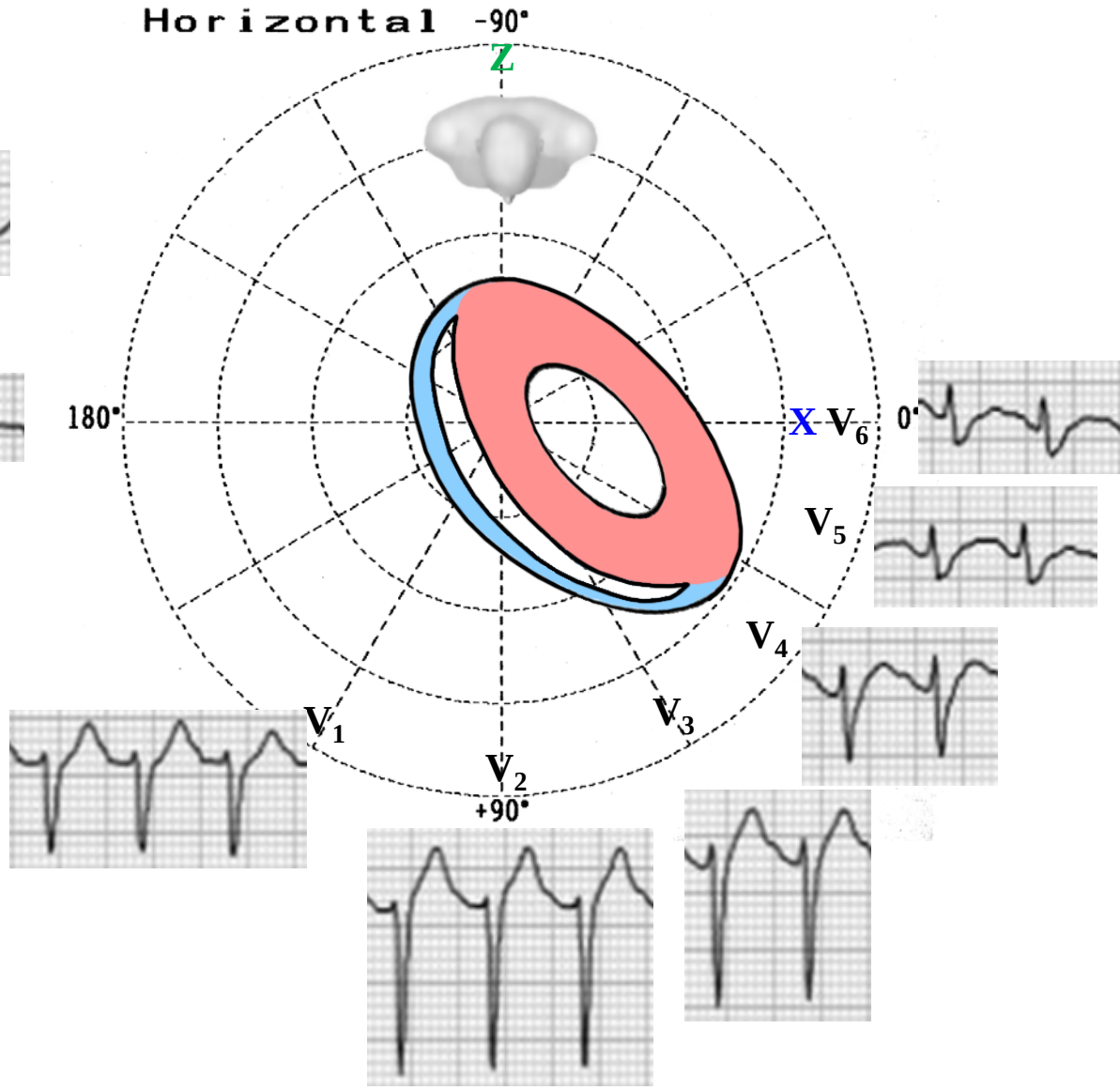
Horizontal
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V5
V4
V1
V3
V2
+90°

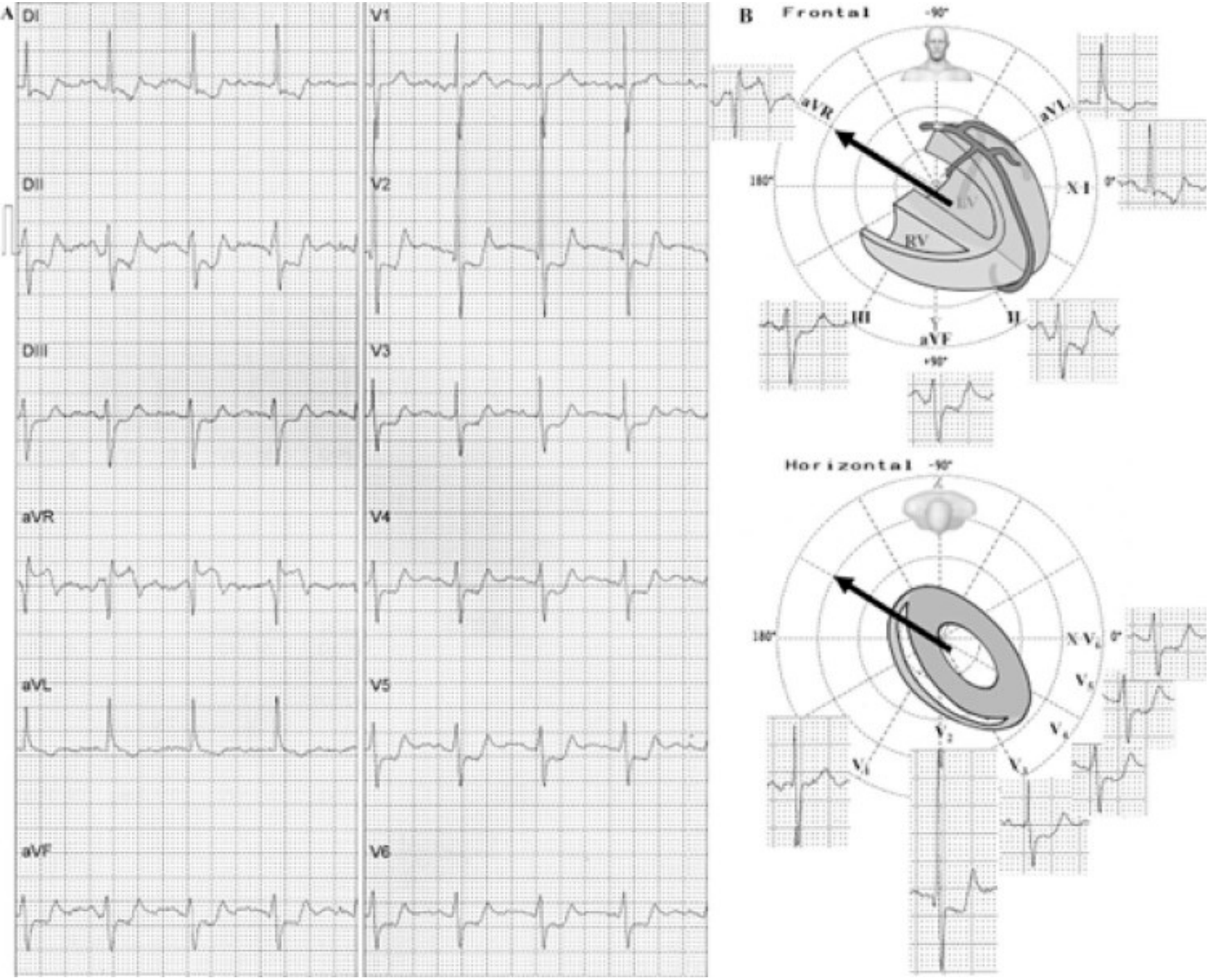
ST elevation in aVR with co-existent multi-lead ST depression indicates subendocardial ischaemia due to O2 supply/demand mismatch.

Clinical causes include:

I. Proximal left anterior descending artery (LAD) stenosis before the first septal perforator branch branche, causing infarction of the basal septum. Such cases will have associated ST elevation in anteroseptal leads. **Infarction of the basal septum**, i.e. a STEMI involving aVR and left septal fascicle Severe triple vessel disease

II. Hypoxia or hypotension, for example following resuscitation from cardiac arrest

III. LMCA sub occlusion (**Andrés Ricardo Pérez-Riera 1, Raimundo Barbosa-Barros 2, Rodrigo Daminello Raimundo 1, Luiz Carlos de Abreu 1, Marcos Célio de Almeida 3, Kjell Nikus 4 Transient Prominent Anterior QRS Forces in Acute Left Main Coronary Artery Subocclusion: Transient Left Septal Fascicular Block Arq Bras Cardiol . 2020 Apr;115(1 suppl 1):1-5. doi: 10.36660/abc.20180363**.. See nex two slides


A
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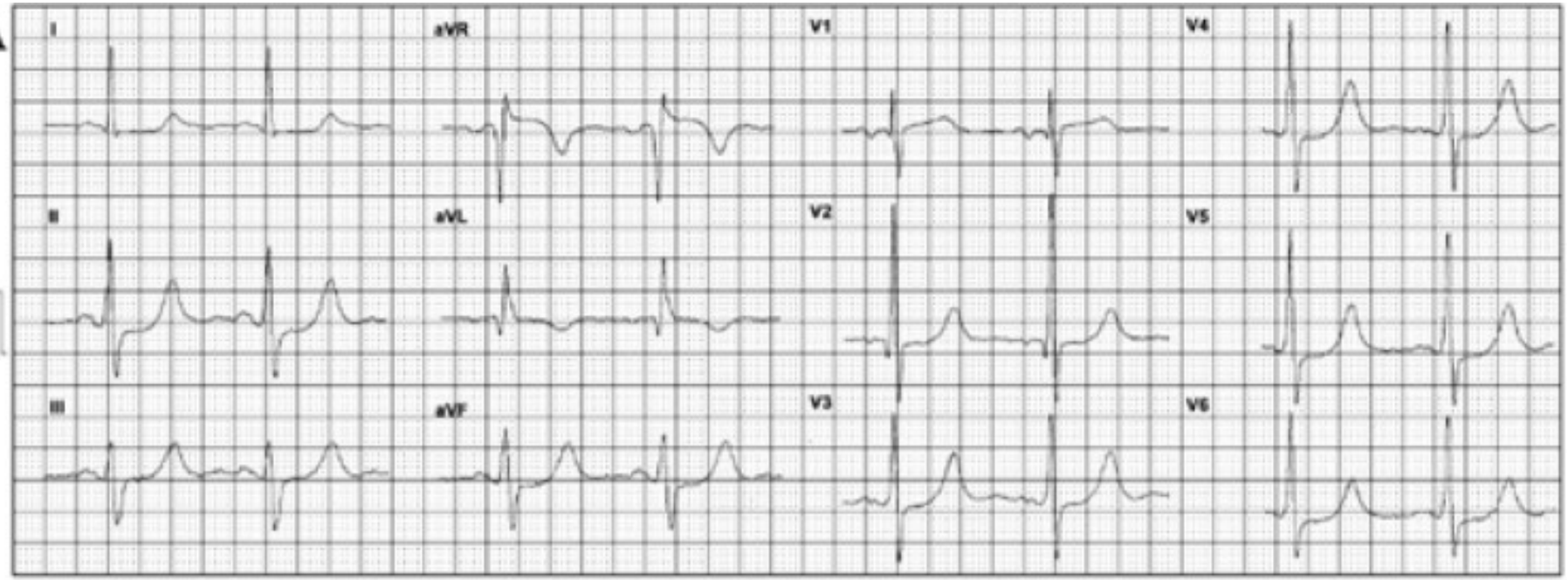
A



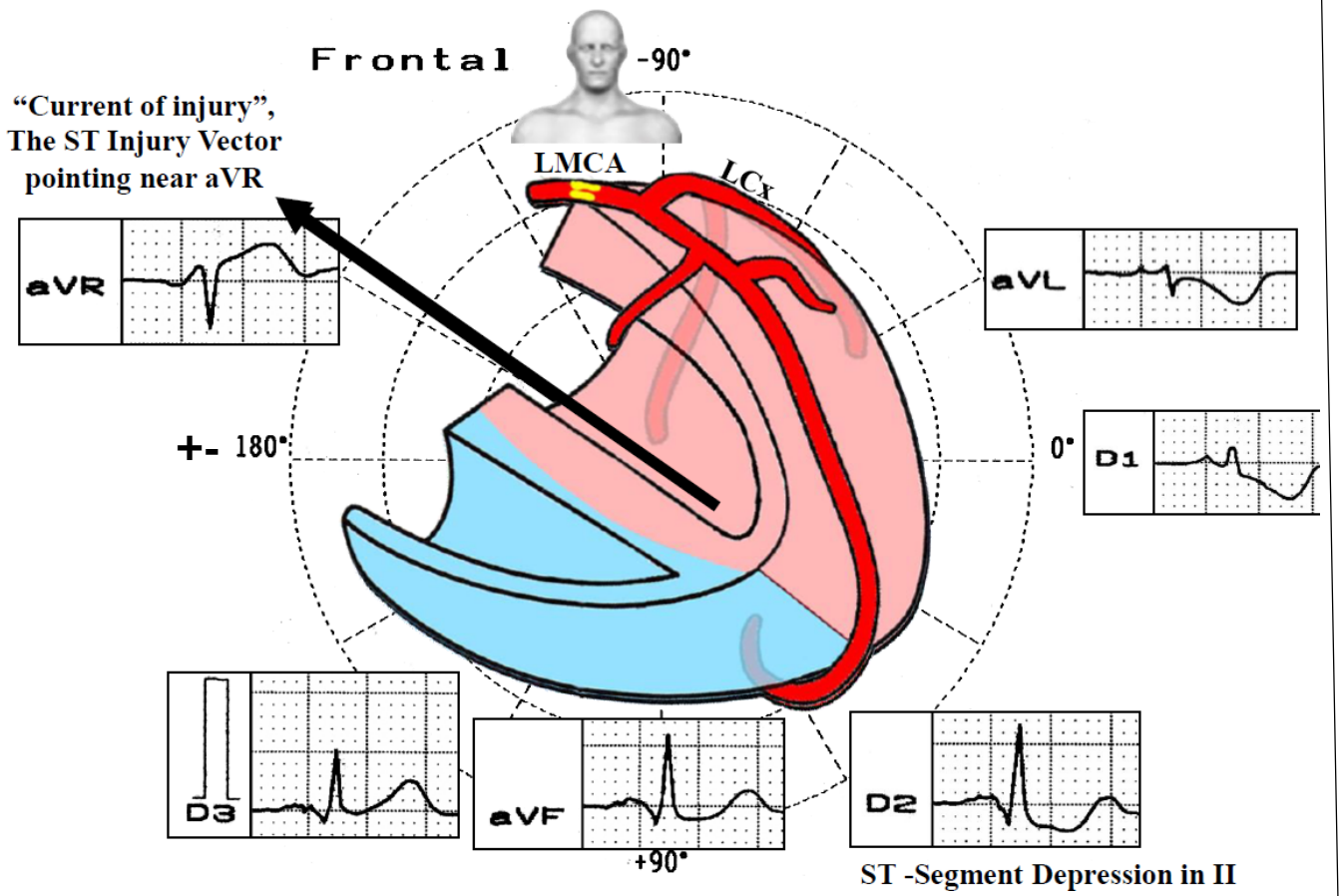
B

Acute LMCA Subocclusion versus Acute LMCA Subocclusion (1:2)

	Acute LMCA Subocclusion	Acute LMCA total occlusion
Frequency	mayor	Very rare
Letal arrhythmias	Less frequent	Frequent
In-hospital mortality	11%	44%
STE in leads I, aVL, and V2–V6	Absent	Present if absence of collateral circulation
Widespread ST depression in ≥7 leads with STE in the aVR and V1	Characteristic (2)	Smaller
STE in leads I, aVL, and V2–V6	No	Present if absence of collateral circulation
NSTEMI	Yes	No
STE in I, aVL, V1–V5	3%	17%
STE in aVR+V1	29%	6%
Injury vector location	On right superior quadrant between 0° and +-180°	On left superior quadrant between 0° and -90°
Prognosis	Better	Catastrophic event frequent SCD and/or cardiogenic shock, high mortality rates and limited methods of successful treatment

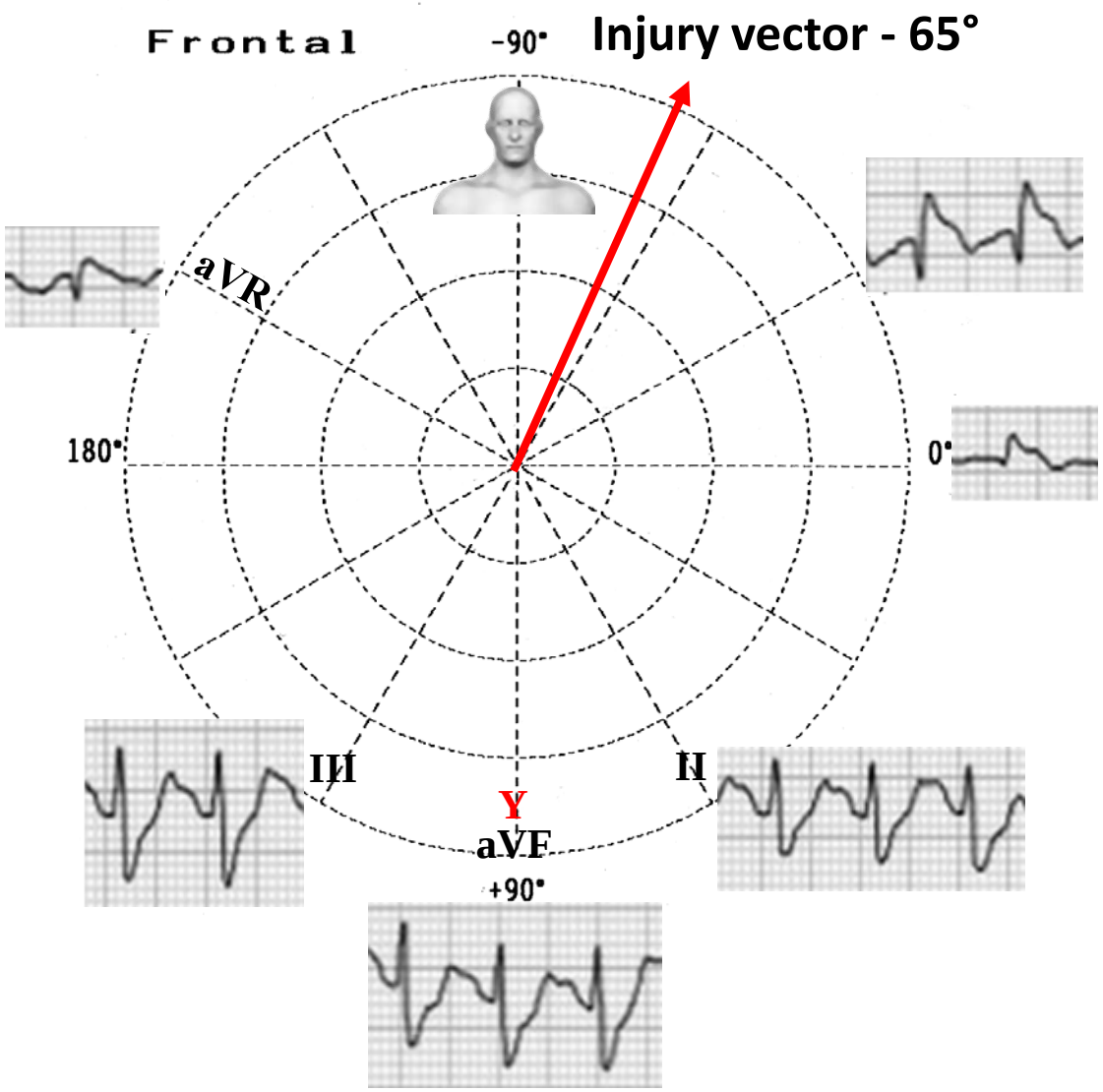
1. Chunwei Liu 1 2, Fan Yang 3, Yuecheng Hu 1, Jingxia Zhang 1, Ximing Li 1, Zhigang Guo 4, Yin Liu 1, Hongliang Cong 1Combining electrocardiographic criteria for predicting acute total left main coronary artery occlusion. Front Cardiovasc Med. 2022 Aug 11;9:936687. doi: 10.3389/fcvm.2022.936687.
2. Yamaji H, Iwasaki K, Kusachi S, Murakami T, Hirami R, Hamamoto H, et al.. Prediction of acute left main coronary artery obstruction by 12-lead electrocardiography. ST segment elevation in lead aVR with less ST segment elevation in lead. *V J Am Coll Cardiol.* (2001) 38:1348–54. 10.1016/S0735-1097(01)01563-7

Acute LMCA Subocclusion



Injury vector location on right superior quadrant between -90° and +-180° at "Northwest Quadrant", no man's land.

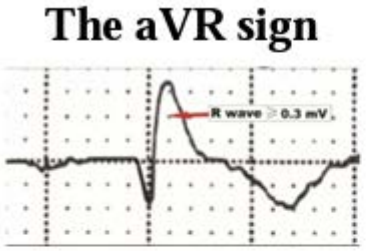
Acute LMCA total occlusion



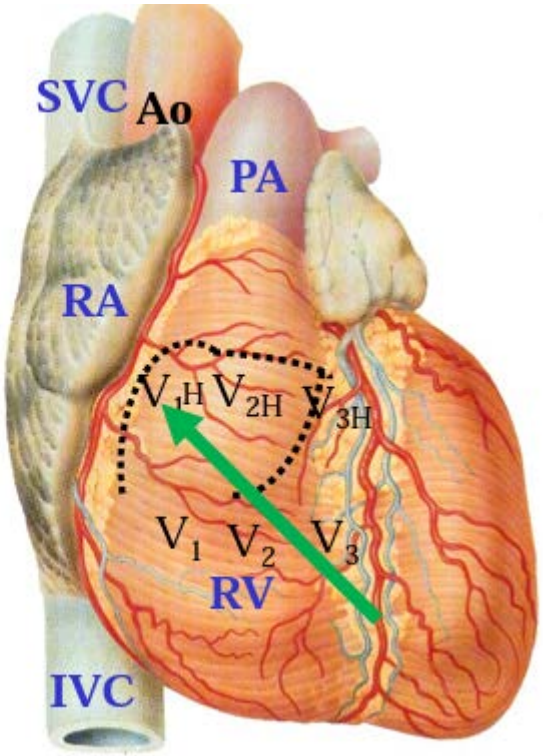
Injury vector location on left superior quadrant between 0° and - 90°

Possible causes of QRS axis located on right superior quadrant between -90° and +-180° at "Northwest Quadrant", no man's land.

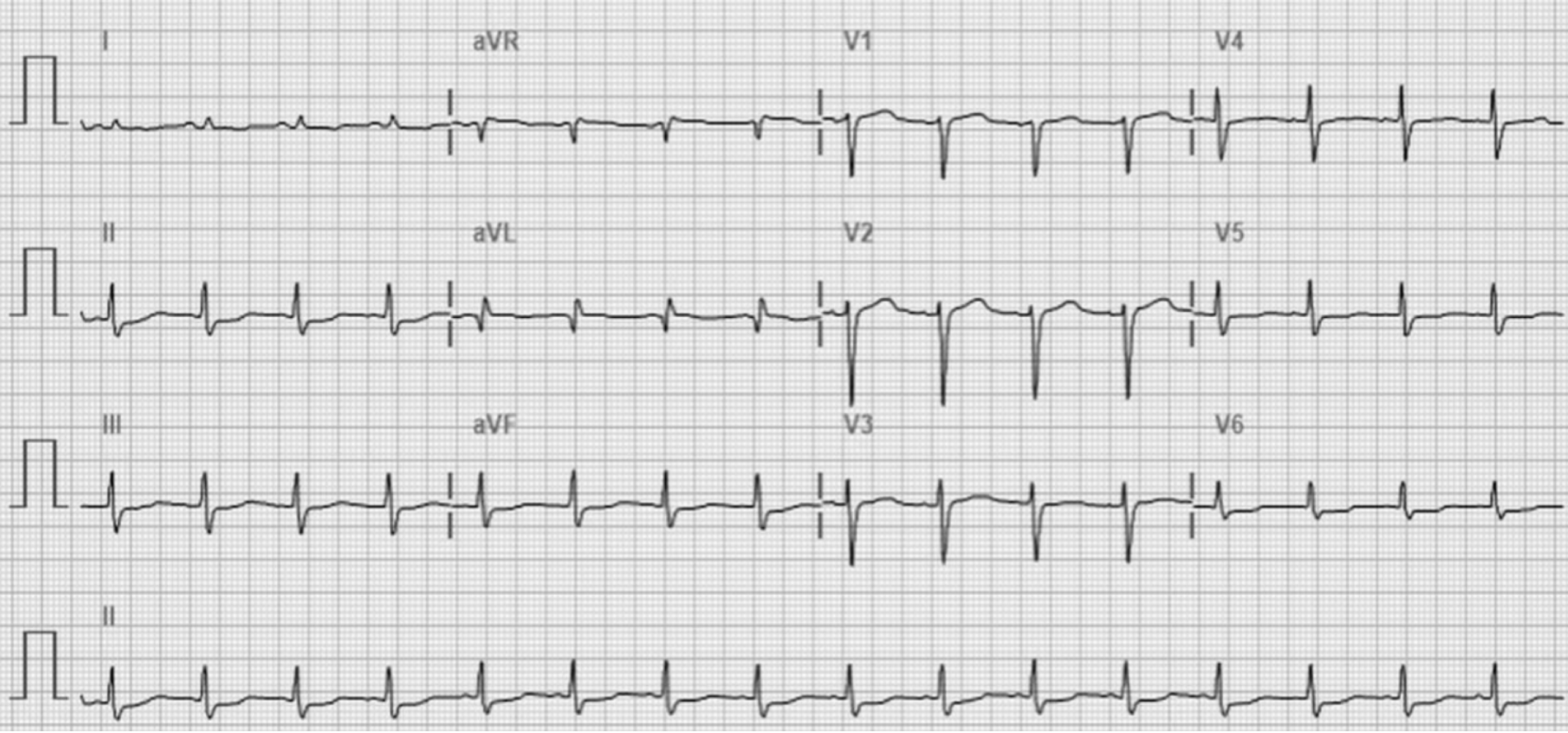
1. Ventricular tachycardia,
2. complexes in lead I and negative QRS complexes in lead
3. Accelerated Idioventricular Rhythm
4. Ventricular ectopy
5. Hyperkalaemia
6. Severe right ventricular hypertrophy
7. Right distal bundle superior peripheral block: eventually observ



High right precordial leads V_{1H}, V_{2H} and V_{3H} and unipolar aVR face the RVOT (A)



1. Andrés Ricardo Pérez-Riera 1, Frank Yanowitz 2, Raimundo Barbosa-Barros 3, Rodrigo Daminello-Raimundo 1, Luiz Carlos de Abreu 1 4, Kjell Nikus 5, Pedro Brugada 6Electrocardiographic "Northwest QRS Axis" in the Brugada Syndrome: A Potential Marker to Predict Poor Outcome JACC Case Rep . 2020 Oct 7;2(14):2230-2234. doi: 10.1016/j.jaccas.2020.07.037. eCollection 2020 Nov 18.
2. Pérez-Riera A.R., Ferreira Filho C., de Abreu L.C. Do patients with electrocardiographic Brugada type 1 pattern have associated right bundle branch block? A comparative vectorcardiographic study. *Europace.* 2012;14:889–897.
3. Pérez-Riera A.R., Ferreira C., Schapachnik E. Value of 12 lead electrocardiogram and derived methodologies in the diagnosis of Brugada disease. In: Antzelevitch C., Brugada P., Brugada J., editors. *The Brugada Syndrome From Bench to Bedside.* Blackwell Futura Publishing; Hoboken, NJ: 2005. pp. 87–110. [Google Scholar]



ECG 7 days later after PCI. Sinus rhythm, HR 96bpm, SÂQRS: +60°, minor nonspecific ventricular repolarization abnormalities. Normal QRS transition zone on precordial leads.

Left main coronary artery (LMCA) disease is usually associated with multi-vessel disease and presents as an acute coronary syndrome (ACS).(**Dwyer N., Kanani R. Left main coronary artery thrombosis. N Engl J Med . 2012 Apr 5;366(14):e21. doi: 10.1056/NEJMicm1105065.)** Isolated stenosis of LMCA is not frequent. LMCA total occlusion typically presents as anterolateral ST-segment MI with or without RBBB with LAFB and ST-segment elevation in aVR. Also the ECG can show complete LBBB associated with the Winter's sign(**Iosif Xenogiannis 1, Fotios Kolokathis 2, Dimitrios Alexopoulos 2, Loukianos S Rallidis 2.. Myocardial infarction due to left main coronary artery total occlusion: A unique electrocardiographic presentation J Electrocardiol. 2022 Nov 9;76:26-31. doi: 10.1016/j.jelectrocard.2022.11.002**). There are few cases of LMCA chronic total occlusion(CTO) presenting as stable ischemic heart disease. CTO: is defined as A complete blockage of a coronary artery for three months or longer. Symptoms include chest pain, shortness of breath, feeling tired. Treatment

Includes medication PCI, or **(CABG)** ,https://www.yalemedicine.org/conditions/chronic-total-occlusion#:~:text=%E2%80%A2A%20complete%20blockage%20of,intervention%2C%20coronary%20artery%20bypass%20graft Several non-atherosclerotic causes, including vasculitis are associated with ostial stenosis of coronary arteries. (**Kumar G.V.R., Agarwal N.B., Javali S., Patwardhan A.M. Takayasu's arteritis with ostial and left main coronary artery stenosis. *Tex Heart Inst J.* 2007;34(4):470–474.**). Although percutaneous coronary intervention (PCI) is an upcoming treatment modality, coronary artery bypass grafting (CABG) remains the preferred treatment option in these patients.(**Zimmern S.H., Rogers W.J., Bream P.R. Total occlusion of the left main coronary artery: the Coronary Artery Surgery Study (CASS) experience. *Am J Cardiol . 1982 Jun;49(8):2003-10. doi: 10.1016/0002-9149(82)90222-3.***). Significant LMCA) disease is found in 5–6% of all patients undergoing coronary angiography. It usually presents as acute coronary syndrome (ACS) and is commonly associated with multi-vessel coronary artery disease (CAD))(**Taggart D.P., Kaul S., Boden**

W.E. Revascularization for unprotected left main stem coronary artery stenosis stenting or surgery. J Am Coll Cardiol . 2008 Mar 4;51(9):885-92. doi: 10.1016/j.jacc.2007.09.067.). LMCA Acute total coronary Occlusion (ATO) a much rarer finding, since these patients usually present as fast cardiogenic shock. LMCA occlusion usually presents as ACS. Since LMCA supplies 75% of the LV in right dominant circulation and 100% in left dominant circulation, ATO LMCA occlusion usually presents as massive infarction and cardiogenic shock a high mortality rate.(**Burgazli K.M., Bilgin M., Soydan N., Chasan R., Erdogan A. Acute left main coronary artery occlusion.** ***Pak J Med Sci. 2013 Jan-Mar; 29(1): 216–217. doi: 10.12669/pjms.291.2819*****).** ATO of LMCA is a very rare condition that exists only with a dominant RCA and excellent collateral supply the inferior wall of the left ventricle.(**Valle M., Virtanen K., Hekali P., Frick M.H. Survival with total occlusion of the left main coronary artery. Significance of the collateral circulation.** ***Catheter Cardiovasc Diagn.*** **1979;5(January):269–275. doi: 10.1002/ccd.1810050308.)** One of the reviews estimated the prevalence of LMCA occlusion to be 0.04%. In these patients, visualization of RCA is easy; however, visualization of distal LCA is difficult due to the dependence on collateral circulation. Patients with normal or near normal LV function generally tend to

have normal distal left vessels and normal RCA. Approximately 50% of the patients with LMCA CTO have disease in RCA. Several studies have highlighted the role of collaterals in preservation of systolic function. However collaterals are not enough to prevent the development of angina.(**Sugishita K., Shimizu T., Kinugawa K. Chronic total occlusion of the left main coronary artery. *Intern Med Tokyo Jpn.* 1997;36(July (7)):471–478. doi: 10.2169/internalmedicine.36.471**.). The most frequent site of LMCA stenosis is the distal bifurcation followed by ostium and the mid-shaft. Several studies have shown that ostial stenosis of LMCA and RCA was more common in females.(**Sasaguri S., Honda Y., Kanou T. Isolated coronary ostial stenosis compared with left main trunk disease. *Jpn Circ J.* 1991;55(December (12):1187–1191. doi: 10.1253/jcj.55.1187**.) Sasaguri et al. reported that patients with ostial lesions were usually younger and presented with fewer risk factors for atherosclerosis.

The etiology in most of the cases is atherosclerotic. Non-atherosclerotic causes include radiation therapy, rheumatoid arthritis, syphilis, Takayasu's arteritis, aortic valve disease, aortic valve replacement, Kawasaki's disease, left coronary ostial isolation due to aortic valve anomalies, injury following PCIs and severe pulmonary artery hypertension (PAH) leading to enlargement of pulmonary arteries and dynamic

LM compression.(**Seabra L.F., Ribeiro H.B., de Barros e Silva P.G.M. Left main ostial compression in a patient with pulmonary hypertension: dynamic findings by IVUS. *Am J Case Rep.* 2015;16(December):899–903.).** Most of these patients present with typical symptoms of angina, have a history of prior MI and may present with symptoms of heart failure. However, some patients may be asymptomatic.

CABG is considered the treatment of choice for LMCA CTO. However, several reports of successful PCI have been published, particularly in patients with protected LCA by previous CABG and patients with good collaterals.**(Trehan V., Mehta V., Mukhopadhyay S., Yusuf J., Arora R. Percutaneous stenting of chronic total occlusion of unprotected left main coronary artery. *Indian Heart J.* 2003;55(April (2)):172–174. 2003 Mar-Apr;55(2):172-4.)** Guidewire selection and crossing of the occlusion are the most crucial steps in CTO PCI.

Recent advances in guidewire technology and crossing techniques yield a success rate of 80–90% in CTO PCI(**Mishra S. Language of CTO interventions–focus on hardware. *Indian Heart J.* 2016;68(4):450–463. doi: 10.1016/j.ihj.2016.06.015**.) PCI can be done either by antegrade or retrograde approach.

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LMCA revascularization remains a critical part of CAD management as it improves patients' prognoses by reducing all-cause and cardiac mortality (**Shah R., Morsy M.S., Weiman D.S., Vetrovec G.W. Meta-Analysis Comparing Coronary Artery Bypass Grafting to Drug-Eluting Stents and to Medical Therapy Alone for Left Main Coronary Artery Disease. *Am. J. Cardiol.* 2017;120:63–68. doi: 10.1016/j.amjcard.2017.03.260**.). While it has long remained the prerogative of the surgeon, the evolution of PCI techniques and the improvement of both stent technology and antithrombotic treatment have led to a debate on the roles that PCI and CABG should play in the treatment of LMCA lesions (**Dąbrowski E.J., Kożuch M., Dobrzycki S. Left Main Coronary Artery Disease—Current Management and Future Perspectives. *J. Clin. Med.* 2022;11:5745. doi: 10.3390/jcm11195745.**). Several randomized controlled trials (RCT) and subsequent patient- and study-level meta-analyses have demonstrated an equipoise between PCI and CABG in a selected, low-risk subgroup of patients in terms of all-cause and cardiovascular mortality, major adverse cardiac events(MACE), MI and stroke, albeit with a higher rate of subsequent revascularization with PCI. (**Bajraktari G., Zhubi-Bakija F., Ndrepepa G., Alfonso F., Elezi S., Rexhaj Z., Bytyçi I., Bajraktari A., Poniku A., Henein M.Y. Long-Term Outcomes**

of Patients with Unprotected Left Main Coronary Artery Disease Treated with Percutaneous Angioplasty versus Bypass Grafting: A Meta-Analysis of Randomized Controlled Trials. *J. Clin. Med.* 2020;9:2231. doi: 10.3390/jcm9072231.) (**Jang A.Y., Kim M., Lee J., Seo J., Shin Y.H., Oh P.C., Suh S.Y., Lee K., Kang W.C., Ahn T., et al. Real-World Treatment Selection Factors and 7-Year Clinical Outcomes between Percutaneous Coronary Intervention and Coronary Artery Bypass Graft Surgery in Left Main Disease. *J. Clin. Med.* 2022;11:503. doi: 10.3390/jcm11030503.**). Deciding between PCI and CABG is essentially based on the patients' comorbidities, particularly diabetes mellitus, the surgical risk as assessed by the STS score or the **EuroSCORE II**, left ventricular ejection fraction (LVEF), the anatomical complexity assessed by the **SYNTAX score** and the need for concomitant valvular or aortic surgery (**Jang A.Y., Kim M., Lee J., Seo J., Shin Y.H., Oh P.C., Suh S.Y., Lee K., Kang W.C., Ahn T., et al. Real-World Treatment Selection Factors and 7-Year Clinical Outcomes between Percutaneous Coronary Intervention and Coronary Artery Bypass Graft Surgery in Left Main Disease. *J. Clin. Med.* 2022;11:503. doi: 10.3390/jcm11030503**.). Bifurcation lesions are frequent with LMCA and have been associated with a higher risk of target lesion failure (TLF) compared to other

non-LMCA bifurcation lesions, thus emphasizing the crucial role of the adequate use of the currently available armamentarium for PCI to improve outcomes. (**Rigatelli G., Zuin M., Gianese F., Adami D., Carraro M., Roncon L. Single versus Double Stenting in NSTEMI Patients with Complex Left Main Bifurcation Disease. *J. Clin. Med.* 2022;11:3559. doi: 10.3390/jcm11123559.**) (**Cha J.-J., Hong S.J., Joo H.J., Park J.H., Yu C.W., Ahn T.H., Kim H.-S., Chun W.J., Hur S.-H., Han S.H., et al. Differential Factors for Predicting Outcomes in Left Main versus Non-Left Main Coronary Bifurcation Stenting. *J. Clin. Med.* 2021;10:3024. doi: 10.3390/jcm10143024.)** One of the first aspects is to adequately evaluate LMCA by using intravascular imaging with intravascular ultrasound or Optical Coherence Tomography(OCT), which may be the only option in case of ostial lesion. Prior to PCI, intravascular imaging may provide useful information on lesion characteristics such as plaque extent and severity, minimal lumen area, cross-sectional characteristics and the involvement of the side branches.

All these information may help define the optimal PCI strategy by determining the diameter and length of the stents and detailing their landing zones. After PCI, intravascular imaging may still identify suboptimal results with incomplete stent deployment, malposition, edge dissection, thrombus or a strut protrusion

(**Olinic D.M., Spinu M., Homorodean C., Ober M.C., Olinic M. Real-Life Benefit of OCT Imaging for Optimizing PCI Indications, Strategy, and Results. *J. Clin. Med.* 2019;8:437. doi: 10.3390/jcm8040437.**). Another way to evaluate lesions of the LMCA is to assess their functional significance with the use of fractional flow reserve or instantaneous wave-free ratio, with cut-off values of, respectively, ≤0.80 and ≤0.89 (**De Rosa S., Polimeni A., De Velli G., Conte M., Sorrentino S., Spaccarotella C., Mongiardo A., Sabatino J., Contarini M., Todaro D., et al. Reliability of Instantaneous Wave-Free Ratio (iFR) for the Evaluation of Left Main Coronary Artery Lesions. *J. Clin. Med.* 2019;8:1143. doi: 10.3390/jcm8081143.**). Physiological assessment is also useful after the PCI to ensure a good hemodynamic result on the treated lesion or a bifurcation branch. Other techniques such as the measurement of the anterior wall thickness of the LMCA by transthoracic echocardiography have also been described, with an adequate sensibility for the diagnosis of fibro-calcific plaque, although further validation is **necessary(Labombarda F., Roule V., Rebouh I., Ruscica M., Watts G.F., Sirtori C.R. Evaluation of Transthoracic Echocardiography in the Assessment of Atherosclerosis of the Left Main Coronary Artery: Comparison with Optical Frequency Domain Imaging (a Pilot Study) *J. Clin. Med.* 2021;10:256. doi: 10.3390/jcm10020256.**).

Because of its specific anatomical characteristics, lesions of the LMCA distinguish from others especially with a greater volume of atherosclerotic plaque, more frequent and severe calcifications, and a common involvement of the distal bifurcation. The latter raises the issue of a one or two stents for the PCI strategy and although some observational studies have reported improved outcomes with a single-stent strategy (**Rigatelli G., Zuin M., Gianese F., Adami D., Carraro M., Roncon L. Single versus Double Stenting in NSTEMI Patients with Complex Left Main Bifurcation Disease. *J. Clin. Med.* 2022;11:3559. doi: 10.3390/jcm11123559.**). a dedicated randomized trial demonstrated a significant reduction in TLF and stent thrombosis with a two-stent strategy with the use of the DK-crush **technique(Chen X., Li X., Zhang J.-J., Han Y., Kan J., Chen L., Qiu C., Santoso T., Paiboon C., Kwan T.W., et al. 3-Year Outcomes of the DKCRUSH-V Trial Comparing DK Crush With Provisional Stenting for Left Main Bifurcation Lesions. *JACC Cardiovasc. Interv.* 2019;12:1927–1937. doi: 10.1016/j.jcin.2019.04.056**.). Considering the large plaque burden and the degree of calcification, plaque modification strategies before stenting, such as rotational, orbital, laser atherectomy or lithotripsy, may be paramount in the setting of LMCA PCI to ensure a proper debulking and good stent expansion, which has been associated with better

outcomes(**Shah C.A., Pfau S.E. Percutaneous Left Main Coronary Intervention: A Review of Plaque Modification in Left Main Percutaneous Coronary Intervention. *J. Clin. Med.* 2018; 7:180. doi: 10.3390/jcm7070180.**).

Much remains to be done to improve outcomes in the setting of LMCA. Although CABG may remain the gold standard in cases of complex lesions and/or patients with diabetes mellitus, PCI remains a valid option for patients too frail to undergo surgery or presenting low-risk lesion.

This is my beloved granddaughter named Lucia, beautiful as grandfather?