MSCT vessel characterization prior to treatment of chronic total coronary occlusions

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**Purpose**

Approximately up 30 to 40% of Patients with coronary artery disease present at angiography at least one occluded artery. Various studies have indicated the presence of CTO as the most important factor of selecting bypass as the choice of the coronary vascular revascularization and only 7 to 15% of chronic total occlusion (CTO) are treated with percutaneous coronary intervention.

Treatment of CTO lesions still represent a challenge for interventionalists. There is an increasing body of evidence that successful revascularization of occluded coronary vessel subtending viable myocardium is associated with survival improvement, better left ventricular function and higher quality of life.

Although the most important factor of procedural failure is due to the inability to cross the occlusion with the guide wire and to reach the distal lumen end. Remarkable progress has been achieved over the past few years pioneered by Japanese interventional cardiologists, also thanks to new guide wires, techniques and dedicated devices they have led to higher procedural success rate and nowadays recanalization may be achieved in more than 80% in hands of experts operators.

The success of CTO recanalization strictly depend on lesion characteristics, that influence the choice of the best percutaneous approach. The most frequent reasons of failure are the inability to reach distal true lumen of the vessel or to cross the lesion with a balloon and procedure stopping due to formation of a long subintimal dissection or evidence of dye extravasation (intramural hematoma or coronary perforation). All these complications greatly depends on the occlusion characteristics; nevertheless occluded vessel can not be correctly demonstrated in standard CA, and therefore interventional procedure on this setting is technically demanding and at increased risk.

The limitations of the traditional angiographic approach depend on the inability to show directly the occluded segment, and to fully characterize the occlusion plaque.

In this context the use of multislice CT coronary angiography (MSCT-CA) permits to image directly the occluded segment and the distal coronary lumen, including an accurate characterization of the occluded segment.

In this poster we will evaluate the usefulness of MSCT-CA in a group of patients with a known diagnosis of coronary occlusion and it's ability to support the procedure by providing extra information not available to standard coronary angiography (CA).
Methods and Materials

We studied a case series of 15 patients, which were diagnosed of chronic coronary occlusion and were not successfully treated during this first procedure.

Eventually within 14 days (mean time 9 days) these patients underwent a MSCT-CA with the purpose to give additional information about anatomy of the occlusion, patency of the distal vessel and presence of calcifications.

MSCT-CA

All the patients underwent a MSCT-CA with a multislice scanner (Aquilion 64, Toshiba Japan) with these scan parameters:

- Collimation 64 X 0.5 mm.
- Pitch, rotation time and number of segment (1 to 5) for the reconstruction method were optimized automatically according the Patient heart rate mean value and range during pre scan breath hold simulation to reach the higher temporal resolution possible.
- There were administered 80 ml of nonionic contrast material (Iomeprol 400mg/ml Bracco, Italy) at a rate of 4.5 ml/sec, followed by a saline chaser bolus of 40 ml at the same rate using a double head injector (Medrad, Indianola USA).
- An automatic bolus-tracking technique triggered the start of MSCT scanning.

Images were reconstructed with retrospective electrocardiography gating, and analyzed off-line on dedicated workstations (Vitrea, Vital Images - USA and Acquarius WS, Terarecon - USA) by operators who were blinded to angiographic data; for each exam were made MIP, MPR, CMPR and 3D reconstructions.

Five patients, who had an heart rate > 65 received IV administration of Esmolol (1 mg/kg) just before the scanning procedure.

Of every Patient were noted occlusion site and characteristics; regarding the occluding plaque were evaluated the occlusion extension, the presence of side branches at the proximal and distal edge, the presence of calcifications and the position of the calcium deposits, the shape of the proximal edge of the occlusion, the tortuosity of the vessel proximal to the occluded segment and finally the amount of distal vessel disease.

In the 3D rendering mode the best projection angle were noted and the C-Arm angle data were provided.
Images for this section:

**Fig. 0:** Aquilion 64 Toshiba Medical Systems - Japan

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Fig. 0: A) measure of the extension of the occlusion; B) presence of gross calcific plaque (arrow head) and presence of collateral branches (arrow).

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Fig. 0: Different presentation of the proximal fibrous cap: A) tapered shape; B) convex shape.

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**Fig. 0:** 3D simil-angiographic reconstruction allows to obtain angle information (B) useful to perform a correct projection during the PTCI (A).

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Results

The analysis of the MSCT-CA of CTO revealed an occlusion length higher than 20 mm in 8 of 15 patients; calcium deposits were observed in 7 cases; there was multivessel disease in 10 cases, tapered stumps in 9 patients, vessel angulation was present in 6 cases and side branches were present at extremities of 5 occlusions (Table 1 on page 9).

In 13 of the 15 cases the percutaneous angioplasty (PTCA), supported by the additional informations on the occluded vessel anatomy, was successful; in two cases the results of MSCT-CA discouraged further endovascular approaches on page 11; the Patients were addressed to surgical treatment.
### Results

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**Fig. 0:** This Table show the CTO characteristics divided per Patient and the success of the PTCI procedures.

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Fig. 0

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Fig. 0

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Conclusion

The use of MSCT-CA in the treatment of CTO is a useful tool, because permit to fully evaluate the extent of the occlusions, the presence of calcifications, side branches and the tortuosity of the occluded tract. The volumetric acquisition allows, thanks to dedicated workstations, to obtain infinite projection of the lesion and permit to correctly characterize the coronary plaque and to image the vessel wall, things that are not fully possible with the standard coronary angiography.

Especially in case of complex CTO MSCT-CA might be a precious support in attempting CTO revascularization; Garcia-Garcia et al. demonstrated how the only independent factor associated with a successful revascularization is the absence of severe calcification; however a better characterization of the occluding lesion might modify the revascularization approach and the PCI device selection.

In consideration of the significant radiation dose of the MSCT-CA, the cardiac CT should not be proposed as standard exam to study any CTO, however it would be performed in patient with unfavorable angiographic characteristic or with a previous failed PCI attempt; the introduction of new generation scanners, with prospective acquisition technique, permit to lower the dose to 1-2 mSv, and would suggest this technique as a standard pre PCI exam in CTO patients.
References

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