Optical coherence tomography showed several fracture points in the intimal and even the medial plaque (Figure 2G and H).

The third patient was an 81-year-old woman with heart disease not amenable to surgical treatment due to distal disease. In an initial step, the proximal right coronary artery was treated with rotational atherectomy. The distal truncus arteriosus and the proximal-medial LAD were both treated in a subsequent step (Video 6 of the supplementary data). The distal LAD was treated with a noncompliant balloon and a 2-mm cutting balloon. The proximal LAD and distal truncus arteriosus were treated with coronary lithoplasty and 2 overlapping DESs. The distal truncus arteriosus required postdilation with a double-layered balloon (Video 7 of the supplementary data).

Based on our preliminary experience, coronary lithoplasty is *a)* a safe and effective procedure for cases in which rotational atherectomy is not an option; *b)* a simple procedure with no learning curve that can be performed using standard guide catheters, and *c)* a procedure that permits protection of the lateral branches. The current balloon profile, however, is lower than that of state-of-the-art noncompliant balloons and needs to be improved, as it requires a catheter of at least 6 Fr. Lithoplasty balloons are currently available in just one length (12 mm) and have a diameter ranging from 2.5 to 4 mm.

In conclusion, coronary lithoplasty is a safe and effective procedure for treating severely calcified coronary lesions and will probably become an important addition to the armamentarium for modifying calcified plaque.[3]

APPENDIX. SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version, at https://doi.org/10.1016/j.rec.2018.11.017.

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Regression of Cardiac Amyloidosis Following Autologous Stem Cell Transplant in Patients With Atypical Magnetic Resonance Imaging Findings

Regresión de amiloidosis cardiaca tras un trasplante autólogo de células progenitoras en pacientes con hallazgos atípicos en la resonancia magnética

To the Editor,

A diagnosis of cardiac amyloidosis often requires histological evidence of amyloid deposits, either in the heart itself or in biopsies from other affected organs because prognosis and treatment vary considerably according to the type of amyloidosis.[1] The appearance of global, subendocardial late gadolinium enhancement (LGE) has been described as highly characteristic of cardiac amyloidosis, and is associated with a ~ 5-fold increase in mortality.[2] However, ~ 7% of the patients present with an atypical LGE pattern such as focal subendocardial or midmyocardial LGE for which the prognostic significance and therapeutic implications are unclear.[3] Regression of cardiac light-chain (AL) amyloidosis has been reported following autologous stem cell transplant (ASCT) or chemotherapy in patients with the characteristic LGE pattern for cardiac amyloidosis.[4,5] However, little is known about the impact of these therapies in patients with atypical patterns of LGE.

Here, we present 3 patients with AL amyloidosis with an atypical LGE pattern who underwent ASCT and serial imaging with cardiac magnetic resonance imaging (RMI) and transthoracic echocardiogram (TTE) before and after treatment (respectively 10, 21 and 23 months). TTE with global longitudinal strain (GLS) and RMI (1.5T) including cine-RMI, LGE, and T_1-mapping were performed before and after ASCT. Left ventricular ejection fraction (LVEF), native T_1-relaxation times, and extracellular volume (ECV) fraction were calculated from RMI images using commercially available software (qmass, Medis Medical Imaging systems, Leiden, Netherlands). GLS was calculated from TTE images using QLAB software (Phillip Medical Systems, Andover, Massachusetts). Clinical evaluation with electrocardiogram and N-terminal pro-B-type natriuretic peptide (NT-proBNP) were also performed. Measurements from before ASCT were compared with those after ASCT using a *t* test.

Patients were aged 63, 64 and 73 years and 1 was female. All patients had biopsy proven AL amyloidosis and underwent ASCT with complete hematological response. These patients were at low risk for ASCT according to the Mayo Clinic staging system. Native myocardial T_1-relaxation time and ECV were increased at baseline and decreased following ASCT (Figure 1, T_1: 1186 ± 30 msec vs 1119 ± 50 msec, $P = .036$ and ECV: $41 \pm 6\%$ vs $28 \pm 10\%$, $P = .026$). LGE was present in 2 patients in the subendocardial inferior and inferolateral walls, and in 1 patient in the subendocardial anterolateral wall. LGE persisted in the post-ASCT MRI but was slightly improved following ASCT (Figure 2). An "apical sparing" pattern of longitudinal strain (ie, abnormal in the basal and mid levels of the left ventricle but relatively normal in the apical levels) was present in all cases. GLS was abnormal at baseline and improved significantly after ASCT ($14 \pm 1\%$ to $-20 \pm 3\%$, $P = .037$),

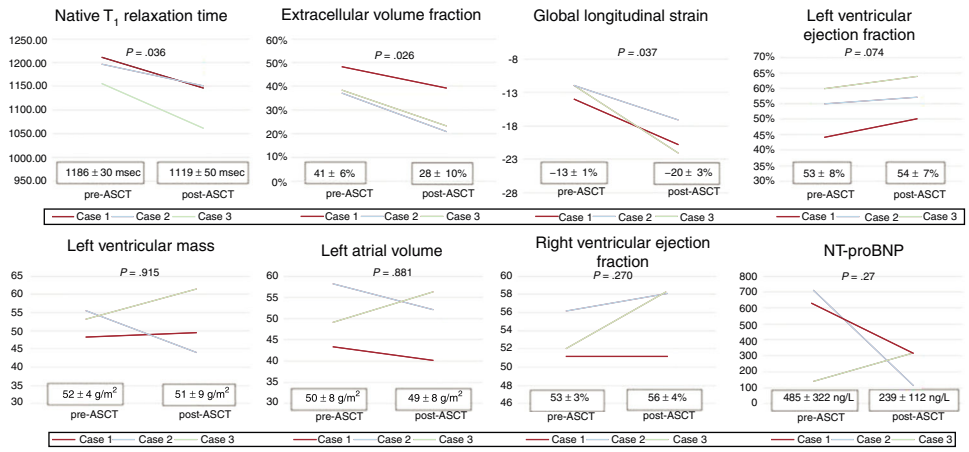

Figure 1. Clinical and Imaging parameters before and after ASCT. ASTC, autologous stem cell transplantation; NT-proBNP, N-terminal pro-B-type natriuretic peptide.

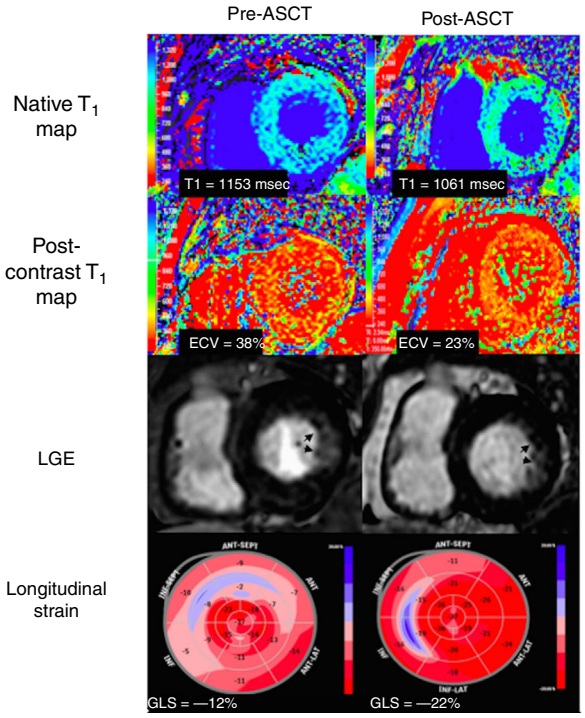

Figure 2. Improvement in native myocardial T1 time, ECV, LGE, and GLS after ASCT in case 3. ASCT, autologous stem cell transplantation; ECV, extracellular volume fraction; GLS, global longitudinal strain; LGE, late gadolinium enhancement.

with statistically inconclusive changes in LVEF (53 ± 8% vs 54 ± 7%, $P = .074$). Left ventricular wall thickness, left atrial volume and NT-proBNP levels did not change significantly after ASCT. Two patients had typical electrocardiogram changes of amyloidosis (low voltages or pseudoinfarct pattern) before ASCT, which improved in 1 after transplant. All patients were alive after a median follow-up of 23 ± 7 months and had good functional capacity.

In our case series, significant improvement in ECV, native myocardial T_1-relaxation times and GLS were noted following ASCT in patients with atypical patterns of LGE, despite no significant changes in the more commonly used imaging-based biomarkers of cardiac amyloidosis, such as LVEF, left ventricular mass, or left atrial volume.

The most likely mechanism to explain this paradoxical behavior is probably differences in the inherent measurement variability of the different parameters. However, other possible explanations might include direct myocardial injury from residual light chain deposits in the myocardium the chemotherapeutic agents used to treat AL amyloidosis. Another possible reason paradoxical behavior might be observed is the development of arrhythmias such as atrial fibrillation or valvular lesions such as mitral regurgitation. A larger cohort of patients would be needed to better understand the underlying reason the various parameters are not uniformly aligned.

Increasing LGE (none, subendocardial, transmural) has been associated with structural and functional changes (eg, increased left ventricle mass, decreased LVEF, left atrial dilation) and worsening tissue characterization (elevated native myocardial T_1-relaxation times and ECV).[6]

Previous research has shown that patients with typical LGE patterns of cardiac amyloidosis have higher left ventricular wall thickness, higher left ventricle mass, and worse diastolic function compared with those with atypical LGE.[3] Interestingly, patients in our case series had impaired longitudinal strain in the basal segments that improved following ASCT, suggesting early myocardial involvement despite the absence of a characteristic global subendocardial LGE pattern.

Regarding NT-proBNP levels, 2 patients had lower levels after treatment and 1 had a small increase. NT-proBNP change is a marker of treatment response only if baseline NT-proBNP > 650 ng/L. In our series, only 1 patient had NT-proBNP levels above this limit and showed a significant decrease after treatment. Interestingly, the RMI and TTE parameters improve despite baseline NT-proBNP levels.

In conclusion, these data suggest that ASCT treatment for cardiac amyloidosis with an atypical LGE pattern can result in regression of the infiltrative process assessed by improvements in native myocardial T_1-relaxation times, ECV, and GLS.

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Left Atrial Appendage Occlusion in Hemodialysis Patients: Initial Experience

Cierre de la orejuela izquierda de pacientes en hemodiálisis: experiencia inicial

To the Editor,

Patients with end-stage renal disease on hemodialysis have a high prevalence of atrial fibrillation (AF), ranging from 3.8% to 27% across the different registries.[1]

AF is associated with an increased risk of systemic thromboembolic events, including ischemic stroke. In patients at a significantly high risk, as indicated by a CHA_2DS_2-VASc score ≥ 2, oral anticoagulation is recommended.

Patients on hemodialysis with associated AF have high thromboembolic and hemorrhagic event rates, reported in up to 5.61 and 8.89 cases per 100 persons-years,[2] respectively, which renders the decision to initiate antithrombotic therapy difficult. In this setting, treatment with vitamin K antagonists has been associated with excess bleeding and worse outcomes, although the results of observational studies diverge markedly and no randomized trials have addressed this question. Furthermore, the clinical guidelines of the main international scientific societies make contradictory recommendations on this topic.[3]

In addition, experience with direct-acting oral anticoagulants in hemodialysis patients is scarce and the associated bleeding risk remains high. As a result, many hemodialysis patients with AF are left without treatment for the prevention of thromboembolic events.[1]

In this setting, left atrial appendage occlusion (LAAO) appears to be an attractive alternative, as it provides protection against thromboembolic events, without increasing bleeding risk. However, to the best of our knowledge, only 1 previous study has assessed the early efficacy and safety of LAAO in hemodialysis patients[4] and no data on long-term efficacy have been published to date.

We performed a single-center retrospective analysis of patients with nonvalvular AF on hemodialysis that had undergone a LAAO procedure, to assess its long-term efficacy and safety in a real-world cohort of hemodialysis patients.

Between January 2013 and January 2018, 14 patients were identified. The mean age at the time of the procedure was 69.21 ± 11.58 years and 10 (71.4%) patients were male. Baseline thromboembolic and bleeding risk were both high with mean CHA_2DS_2-VASc score of 4.5 ± 1.45 and mean HAS-BLED of 5.0 ± 0.96. LAAO was recommended because of previous significant bleeding in 11 patients (78.6%), labile international normalized ratio in 5 (35.7%), and hematological disorders in one patient (7.1%).

LAAO was performed with a Watchman device (Boston Scientific) in 7 patients, with an Amulet device (Abbott Vascular) in 6 patients, and with an Ultraseal (Cardia Inc) in 1 patient. Device deployment was successful in all cases and no device-related or periprocedural complications developed, with the exception of an allergic reaction to iodine contrast in 1 patient (Table 1). All patients were successfully discharged home within 2 days and there were no early deaths or complications at 30 days.

Postprocedural antithrombotic management included a 45-day period of dual antiplatelet therapy in 12 patients (85.7%), and single antiplatelet therapy with low-dose aspirin thereafter.

During a median follow-up of 585 days, 4 patients had bleeding complications, with 3 BARC 2 minor bleeding events and 2 BARC 3a hemorrhage, requiring transfusion. Importantly, no thromboembolic events were recorded during follow-up.

The usefulness of LAAO in patients with chronic kidney disease has been previously described. LAAO has shown comparable procedural safety among patients with and without chronic kidney disease and has been proven to be effective in significantly reducing cerebrovascular and bleeding rates at all chronic kidney disease stages compared with the expected annual risk.[5,6] However, only 1 previous study[4] has reported the preliminary feas-

Table 1
Patient Follow-up

Early follow-up	Number of events	Event description	Median time to event (d)
Periprocedural complications (first 72 h)	1	Allergic reaction to iodine contrast	_
In-hospital mortality	0	0	_
30-day mortality	0	0	_
Long-term follow-up	Number of events	Event description	Median time to event (d)
Stroke/transient ischemic attack	0	0	_
Bleeding	4	BARC 2 bleeding events: 3 BARC 3a bleeding events: 1	129

BARC, Bleeding Academic Research Consortium.