Clinical significance and prevalence of valvular strands during routine echo examinations

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Aims
Lambl’s excrescences (valvular strands) have been associated with an increased embolic risk. In previous studies, valvular strands have mostly been detected by transoesophageal echo (TEE). The current high-resolution echo systems allow better detection of valvular strands often even by transthoracic echocardiography (TTE). We attempted to determine the incidence of valvular strands during routine echo exams, TTE and/or TEE, and their relation to the cardiovascular risk factor, co-morbidities, and outcome.

Methods and results
Over 21 000 echo exams were performed at our hospital during 2008–12 and were searched for reporting of valvular strands. One hundred and fifty such studies were identified and the presence of valvular strands was confirmed. These patients were then evaluated for clinical characteristics, co-morbidities, and outcome, and compared with 150 age- and gender-matched patients without valvular strands. Incidence of valvular strands was maximal at age 61–70 (0.94%), and they were found more commonly in men than in women, 92 vs. 58, \( P < 0.00001 \). Valvular strands occurred more often on the aortic than on the mitral valve, 125 vs. 36, respectively, \( P < 0.00001 \), were more often associated with thickened or calcified aortic or mitral valve, and occupied the ventricular side of the aortic valve and the atrial side of the mitral valve, \( P < 0.00001 \). Embolic events occurred in 40 of the 150 patients with strands (27%). Valvular strands were not associated with increased mortality.

Conclusion
Valvular strands (Lambl’s excrescences) appear not to affect life expectancy, but are often associated with embolic/cerebrovascular events, are more common in older patients, in men than in women, and are more commonly located on the aortic than on the mitral valve.

Keywords
Valvular strands

Introduction
Lambl’s excrescences, thin filiform mobile processes, referred often as valvular strands, were first described by Vilem Dusan Lambl in 1856 on the aortic valve. Valvular strands have been described as a single strand, in clusters, or raw, their diameter < 1 mm, and length 1 – 10 mm. The pathogenesis is believed to be related to endocardial lesions in areas of high stress (valvular closure lines). They are composed of a central core of elastic connective tissue and a layer of endothelial cells. They lack blood vessels, which explain the lack of granulation tissue at their base. The differential diagnosis includes fibroelastoma, thrombi, and vegetations. Fibroelastomas usually occur away from the valvular lines of closure, are larger, and more gelatinous than strands. Vegetations are usually associated with clinical signs of infective endocarditis and valvular dysfunction. The Libman Sacks and thrombotic vegetations are usually rounded or sessile, located on any part of the leaflets, and lack independent mobility. Being most common on cardiac valves, strands may rarely be seen on the interatrial septum and on papillary muscles and chordae.

Valvular strands, previously described only on transoesophageal echo (TEE), have been associated with ischaemic stroke and transient ischaemic attack, especially in younger patients, have been seen on both mitral and aortic valves, occurring equally in men and women, and have not been associated with thickened valves.

In a retrospective analysis, valvular strands on native and prosthetic valves were found in 5.5% of patients referred to TEE. Of 41 TEE studies with valvular strands vs. 41 controls, strands were associated with systemic embolism and were more common on the
mitral than on the aortic valve. In that study, valvular strands were found on mechanical valves in a minority of the patients: 3 of 86 (3%).

With the development of the current high-resolution echo systems, valvular strands can often be detected on transthoracic echocardiography (TTEs). In the current study, we evaluated retrospectively the prevalence of strands detected on TTE and/or TEE, and their relation to the clinical setting, cardiovascular risk factors, and comorbidities.

**Methods**

Over 21,000 echo exams, performed during 2008–12 at the echo lab at Assaf Harofeh Medical Center, were searched for the reporting of strands. One hundred and fifty exams with definite valvular strands were selected. Valvular strands were defined as filiform mobile processes (Figure 1). Valvular strands were measured and investigated in relation to the involved valve, valvular dysfunction, and valve’s appearance. Indications for the echo examination, demographic data, relevant risk factors (hypercholesterolemia, diabetes mellitus, hypertension, coronary artery disease, peripheral vascular disease, stroke, transient cerebral ischaemic events, and other embolic events) were taken into account when available. Significant co-morbidities such as advanced renal failure, malignancy, and mortality data according to the Ministry of Internal Affairs were determined. A control group of 150 patients who underwent echo exam during the same period and had no valvular strands was created. These patients were age- and gender-matched to the 150 patients with valvular strands. Their clinical data with all the relevant risk factors and outcome data were compared with the group with strands. Echo exams were performed on General Electric echo systems—Vivid 7, Vivid 9, Vivid I, and Vivid 3 with a standard transducer 1.7–4 MHz. All examinations were interpreted by experienced readers. TEE exams were performed on the same systems.

**Results**

Of the 150 patients with strands, 92 were men and 58 were women ($P < 0.00001$), Table 1. In the vast majority of patients, echo exam was performed during hospitalization (114 vs. 36, $P < 0.00001$). Mean age was 61±17 years. Incidence of strands according to the patients’ age normalized for the number of echo exams in the same age groups during the study period reached peak at age group 61–70 (0.94%) (Figure 2). All 150 patients underwent detailed transthoracic echocardiographic examination. Eighty-five patients of them underwent TEE as well.

In 60 patients, valvular strands could be detected only on TEE, and in two patients, transthoracic echo was more diagnostic. The most frequent indications for echocardiographic exam were searched for an embolic source—34 and endocarditis—40. Other indications for echo exam included the evaluation of chest pain, coronary ischaemic events, and before cardioversion. The vast majority of valvular strands occurred on native valves (95%). In seven exams, strands were found on prosthetic valves—six on aortic and one on mitral. The mean size of strands was $6.5 \pm 2.4$ mm, and in 37 patients several strands ($>1$) were found. The aortic valve was involved more often than the mitral, 126 vs. 36, $P = 0.00001$, Table 1. Aortic strands were prevalent on the ventricular side of the valve (101 vs. 33, $P < 0.00001$). Strands on the mitral valve were more frequent on the atrial than on the ventricular aspect (34 vs. 2, $P < 0.00001$). Strands were more often found on thickened or calcified aortic valves than on normal valves (102 vs. 23, $P < 0.00001$) and were more often accompanied with some degree of aortic regurgitation or stenosis (80 vs. 45, $P < 0.00001$).

Strands on the mitral valve also occurred more often on abnormal valves: thickened or calcified, or in association with mitral valve prolapse, or prosthetic valves (24 vs. 12, $P < 0.005$), and were accompanied by some degree of mitral regurgitation (33 vs. 3, $P < 0.005$). In one patient, a strand was found on the pulmonic valve (Figure 3).

There was no significant difference in mortality between patients with valvular strands and the control group (Table 2). Hypertension, diabetes, renal failure, and coronary artery disease were not significantly different between both groups. Embolic events included: stroke, transient ischaemic attack, eye, and spleen emboli. They occurred in 40 of 150 patients with strands ($\approx 27\%$). Atrial fibrillation was found during echo examination or per history in 22.7% of patients with strands vs. 15.3% in controls ($P = 0.1$, non significant (NS)). Thirty-one patients underwent a follow-up echo during the study period for unrelated indications—valvular strands were found in 27 of them without apparently significant changes when compared with the first study (Figure 4).

**Table 1** Characteristics of patients with strands

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Strands</th>
<th>Significant value, $P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender: M/F</td>
<td>92/58</td>
<td>$&lt;0.00001$</td>
</tr>
<tr>
<td>TEE</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Admission/ambulatory</td>
<td>114/36</td>
<td>$&lt;0.00001$</td>
</tr>
<tr>
<td>AV/MV</td>
<td>126/36</td>
<td>$0.00001$</td>
</tr>
<tr>
<td>Abnormal AV/N</td>
<td>102/23</td>
<td>$&lt;0.00001$</td>
</tr>
<tr>
<td>AI and AS vs. no AI/AS</td>
<td>80/45</td>
<td>$0.00001$</td>
</tr>
<tr>
<td>Strands direction LV/Ao</td>
<td>101/33</td>
<td>$&lt;0.00001$</td>
</tr>
<tr>
<td>Abnormal MV/N</td>
<td>24/12</td>
<td>$&lt;0.005$</td>
</tr>
<tr>
<td>MR/N</td>
<td>33/3</td>
<td>$&lt;0.005$</td>
</tr>
<tr>
<td>Strands direction: LA/LV</td>
<td>34/2</td>
<td>$&lt;0.00001$</td>
</tr>
<tr>
<td>Pulmonic valve</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Prosthetic valve AV/MV</td>
<td>6/1</td>
<td></td>
</tr>
</tbody>
</table>

AV, aortic valve; MV, mitral valve; AI, aortic regurgitation; AS, aortic stenosis; LV, left ventricle; Ao, aorta; LA, left atrium; MR, mitral regurgitation.
In this study, we evaluated the prevalence of valvular strands (Lambl’s excrescences), as found incidentally during routine echocardiographic examinations in a busy echo lab. The incidence of valvular strands during echo exams was maximal at the seventh decade, 0.94%. After the age of 70, valvular strands were less often visualized, possibly due to more significant calcification on the valves.

First described on a native aortic valve, strands can be found on all native cardiac valves, and are more common on the left side: mitral (68–76%), aortic (38–50%), and right-sided (<10%), and have been found in both men and women. Their association with an increased risk of embolism has been somewhat controversial. In some of the previous studies, strands were more prevalent on the mitral than on the aortic valve.8–10

In our study, strands were more often found in men than in women. In addition, they were found more often on the aortic than on the mitral valve, a finding which may be explained by a higher stress in the aortic region. Most of these valves appeared abnormal—thickened or calcified, a finding which is in discordance with previous data.7

We found strands on prosthetic valves in 7 of 150 patients (4.6%), 6 on an aortic valve (one of them biological), and 1 on a mechanical mitral valve. This is slightly higher than in a previous work published in 1995—3% of 86 patients. The composition of prosthetic valvular strands is controversial: fibrinous vs. collagenous.11 Prosthetic valvular strands may be related to inadequate anticoagulation,12,13 and may develop after thrombolytic therapy for a stuck prosthetic mitral valve.14 This may serve as supportive evidence for their fibrinous component. On the other hand, collagenous strands free of fibrin were identified in a neurologically asymptomatic patient with recurrent aortic valve replacement.15 Hypocellular collagenous strand typical of Lambl’s excrescences and negative for fibrin was found in a young patient with a prosthetic aortic valve and recurrent stroke.16 Definition of the pathological nature of valvular strands in our patients is beyond the scope of the current study. Our goal was to determine the prevalence of valvular strands on native and prosthetic valves with modern echocardiographic systems during routine echocardiography studies.

Relation of valvular strands (Lambl’s excrescences) to cerebral7,9,10,17,18 and systemic embolism8 has been observed earlier.

In our study, cerebral ischaemia was frequent in patients with valvular strands (~27%) and appeared not to have affected the mortality outcome. Although our control group represented well the general population of patients referred to the echo lab in our hospital, comparing the prevalence of stroke/embolism between this group and the group of patients with strands may not be appropriate due to a possible selection bias.

With the development of echocardiographic imaging, detection of valvular strands with transthoracic echocardiography is now possible and is more common, but the gold standard for the detection of valvular strands is TEE examination. Being detected once, strands can be followed by transthoracic echo, and based on the current study, they often remain unchanged, which is in concordance with

**Table 2 Co-morbidities and the outcome of patients with strands vs. control**

<table>
<thead>
<tr>
<th>Comorbidities/Outcome</th>
<th>Patients</th>
<th>Control</th>
<th>Significant values</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN</td>
<td>94</td>
<td>86</td>
<td>NS</td>
</tr>
<tr>
<td>DM</td>
<td>50</td>
<td>54</td>
<td>NS</td>
</tr>
<tr>
<td>RF</td>
<td>24</td>
<td>24</td>
<td>NS</td>
</tr>
<tr>
<td>CAD</td>
<td>56</td>
<td>51</td>
<td>NS</td>
</tr>
<tr>
<td>Embolism (stroke, TIA, spleen, eye)</td>
<td>40</td>
<td>20</td>
<td>NA</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>64</td>
<td>79</td>
<td>NS</td>
</tr>
<tr>
<td>Significant co-morbidities</td>
<td>57</td>
<td>42</td>
<td>NS</td>
</tr>
<tr>
<td>Died</td>
<td>23</td>
<td>24</td>
<td>NS</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>34</td>
<td>23</td>
<td>NS</td>
</tr>
</tbody>
</table>

HTN, hypertension; DM, diabetes mellitus; RF, renal failure; TIA, transient ischaemic attack; CAD, coronary artery disease; NA, not applicable; NS, non significant.

**Figure 2:** Incidence of strands in different age groups. Strands reach peak during the seventh decade.

**Figure 3:** Strands on pulmonic valve (arrow). PV, pulmonic valve; RVOT, right ventricular outflow tract; AV, aortic valve.

**Discussion**

In this study, we evaluated the prevalence of valvular strands (Lambl’s excrescences), as found incidentally during routine echo examinations in a busy echo lab. The incidence of valvular strands during echo exams was maximal at the seventh decade, 0.94%. After the age of 70, valvular strands were less often visualized, possibly due to more significant calcification on the valves.

First described on a native aortic valve, strands can be found on all native cardiac valves, and are more common on the left side: mitral (68–76%), aortic (38–50%), and right-sided (<10%), and have been found in both men and women. Their association with an increased risk of embolism has been somewhat controversial.8,9 In some of the previous studies, strands were more prevalent on the mitral than on the aortic valve.8–10

In our study, strands were more often found in men than in women. In addition, they were found more often on the aortic than on the mitral valve, a finding which may be explained by a higher stress in the aortic region. Most of these valves appeared abnormal—thickened or calcified, a finding which is in discordance with previous data.7
The current study supports previously observed association between valvular strands and embolic events. These results may indicate that antiplatelet and perhaps anticoagulation therapy in patients with valvular strands should likely be recommended.

**Limitations**

Our study is retrospective, based on hospital records. Detection of strands had not been the main scope of these echo examinations and under-diagnosis of such findings is likely. Therefore, the current study may indicate the prevalence of valvular strands (Lambl’s excrescences), found in a busy echocardiography laboratory during routine studies, but not the true number of patients with valvular strands, which is possibly higher.

Although outcome data, based on the reports of the Ministry of Internal Affairs, are accurate in some ambulatory patients, detailed clinical characteristics may not have been complete.

**Conclusions**

(i) Valvular strands (Lambl’s excrescences) can often be detected by routine transthoracic echocardiographic examinations, while transoesophageal echocardiography is the gold standard for their detection.

(ii) Valvular strands do not appear to affect mortality, may occur most commonly during the seventh decade, and were found more often in males. Valvular strands occupy usually the ventricular portion of the aortic valve and the atrial portion of the mitral valve, and are more often found on the aortic than on the mitral valve. They often occur on morphologically abnormal, thickened, or calcified valves.

(iii) Our study confirms previous observations that strands appear to be associated with cerebrovascular/embolic events.

**Conflict of interest:** none declared.

**References**


**IMAGE FOCUS**

Integrated CT ad MR imaging in alcohol-related isolated left ventricular fatty infiltration

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A 68-year-old man was admitted to our hospital with dyspnoea and atypical chest pain.

He had no risk factors for coronary artery disease (CAD) except for mild obesity (BMI: 25.1) and his clinical history was noteworthy for heavy alcohol consumption (~4 L of beer/day in the last 10 years).

No alterations were present at blood exams and basal/stress-ECG but a transthoracic echocardiography performed at admission revealed a globally reduced biventricular systolic function.

Cardiac CT excluded the presence of underlying CAD; however, curvilinear hypodense meso-epicardial stripes were depicted within the left ventricular (LV) lateral wall, characterized by a fat-like mean attenuation value of -80 HU (Panels A and B).

Cardiac magnetic resonance confirmed a predominant subepicardial fatty deposition exclusively located within the LV lateral wall (Panel C), with combined homogenous late enhancement located within the same segments showing a typical ‘non-ischaemic’ pattern of distribution with subendocardial layer sparing (Panel D). Increased interventricular septal thickness was noted (18 mm), together with a mild thickening of the LV lateral wall (13 mm). LV functional analysis demonstrated hypo-dyskinesia of the lateral wall and reduced ejection fraction (41%; Supplementary data online, Video S1), with preserved volumes.

Symptoms gradually disappeared within 1 week after admission and patient signed for discharge refusing any pharmacological treatment. Heavy alcohol consumption has shown to be associated in rare cases to lipomatous myocardial metaplasia without significant arrhythmias; however, the underlying pathological mechanisms are still poorly understood. CT and MR imaging allows its non-invasive recognition avoiding further invasive procedures.

Supplementary data are available at European Heart Journal — Cardiovascular Imaging online.

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