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General Review

Significance and Risk Factors for Intraprosthetic Mural Thrombus in Abdominal Aortic Endografts: A Systematic Review and Meta-analysis

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Background: The detection of intraprosthetic thrombus (IPT) deposits is a common finding during follow-up for endovascular abdominal aneurysm repair (EVAR); however, its clinical significance is still debated. The aim of this study was to determine if IPT represents a risk factor for thromboembolic events (TEs; endograft or limb thrombosis, or distal embolization) after EVAR.

Methods: A systematic review of English literature was undertaken until November 2017. Studies providing 2-group comparison (patients with IPT development on postoperative computed tomography angiography versus patients without IPT) with extractable outcome data (TE related to IPT and/or risk factors for IPT development) were included. Meta-analysis was performed when comparative data were given in 2 or more articles.

Results: Five single-center studies (808 patients) were analyzed. IPT detection at any time during follow-up occurred in 20.8% (168/808) of patients. Extractable data for postoperative TE were available in 4 studies (613 patients): on comparative meta-analysis, IPT was not significantly associated with TE occurrence during follow-up (odds ratio 2.25, 95% confidence interval [CI] 0.50−10.1; $P = 0.29$). IPT is generally detected during the first year after EVAR (maximum reported median: 12 months, range: 1.2−23). Polyester graft material (odds ratio 2.34, 95% CI 1.53−3.58; $P < 0.001$) and aorto-uni-iliac configuration of the endograft (odds ratio 3.27, 95% CI 1.66−6.44; $P = 0.001$) were confirmed as risk factors for IPT formation on meta-analysis. The literature systematic review suggests that IPT formation may be also associated with long main bodies and large necks.

Conclusions: IPT detection on postoperative computed tomography angiography was not significantly associated with the occurrence of TE over time. The aorto-uni-iliac configuration and the use of polyester fabric for endografts were confirmed as risk factors for IPT development.

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INTRODUCTION

Endovascular abdominal aneurysm repair (EVAR) has been associated with higher rates of reinterventions during follow-up than open repair.[1] A common finding after EVAR is the formation of intraprosthetic thrombus (IPT) deposits, with a reported incidence of up to 33%.[2] In contraposition to other common post-EVAR complications, such as endoleaks or migrations, incidence and risk factors for IPT have not been thoroughly investigated in literature. Furthermore, the clinical management of this condition is currently not standardized, and its role on postoperative graft thrombosis or embolic events is still debated. In addition, there is no agreement among authors about the name of this condition (it has been described using various terms such as ''endograft mural thrombus'' or ''circular or semicircular thrombus''), or even its definition.[3,4] Indeed, while some authors defined IPT as the presence of a thrombus thickness of at least 2 mm extended >25% of the main body's surface, others referred to it as the presence of a circumferential layer of thrombotic material regardless of the thickness.[2,5]

The aim of this systematic review was to present clinical and imaging characteristics of IPT after EVAR described in literature, focusing on risk factors that may lead to IPT and potential complications which may result from this condition. When comparative data were available, a meta-analysis was undertaken.

MATERIALS AND METHODS

Data Sources and Search Strategy

Scientific publications about IPT after EVAR for abdominal aortic aneurysms (AAAs) were searched in PubMed, Web of Science, and Scopus without restriction on date or publication type. Reference lists were also examined to add suitable studies. Only literature in English language was considered. The last search date was November 6, 2017. The following search terms were used for PubMed: ''(evar odds ratio [OR] endograft* OR endoprosthesis) AND (thrombus OR thrombotic OR deposit*) AND (mural OR intraprosthetic OR intraluminal OR intragraft)''. The research was conducted by 2 authors (P.P. and C.B.M.), and, in case of controversies, a consensus was reached.

This study was performed in accord with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement.[6]

Study Selection

Randomized controlled trials, cohort studies, and case series were suitable for inclusion. Inclusion criteria were as follows: (i) patients who underwent EVAR; (ii) reported follow-up with computed tomography angiography (CTA); (iii) 2-group comparison (patients with IPT development versus patients without IPT); and (iv) presence of extractable outcome data (risk factors for IPT and/or thromboembolic events (TEs) related to IPT). We excluded articles dealing with endovascular repair of other arterial segments (e.g., thoracic-EVAR), use of multilayer flow modulator, case reports, non-English language articles, or experimental studies. In case of articles containing, or suspected to contain, duplicate data, only the most recent one was selected for extraction.

Data Extraction and Outcome Measures

Data were independently extracted by 2 authors for each selected study (P.P. and either C.B.M., M.A., A.U., G.R., or E.G.). Disagreements were resolved by the senior author (A.F.). Extracted data were the following: study design (type of study, publication type, retrospective/prospective data analysis, and definition of IPT), cohort characteristics (number of patients, number of patients with/without thrombosis, time frame of the study, follow-up length), and baseline demographics (age, gender, and aneurysm diameter). All nondeducible data were reported as ''not specified''.

Two main outcomes were drafted before data extraction:

1. TE;
2. IPT occurrence.

TEs were defined as any ischemic event related to the aortic endograft (endograft occlusion, iliac limb occlusion, acute limb ischemia, and blue toe syndrome). Specifically, the predictive role of preexisting IPT in determining TE was investigated.

''IPT occurrence'' was defined as the appearance of IPT on any postoperative CTA at any time during follow-up, regardless of the thickness of the thrombus layer. Specifically, potential risk factors for IPT occurrence were investigated. Risk factors were analyzed when given in 2 or more included articles.

Statistical Analysis

Data were tabulated into a Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, WA). The