

Early Cerebral Micro-Embolization After Cardiac Valve Surgery: A Transcranial Doppler Study Using a Solid–Gaseous Embolus Classification Algorithm

Sayonara Daal [1], Ruud WM Keunen [1], Geert Jan Romers [2], Ali Falsafi [1], Gerard Hooohenkerk [1], Khalil Ayan [1], Serena Mariani [1], Eric Teeuws [1], Paulien van Kampen [3].

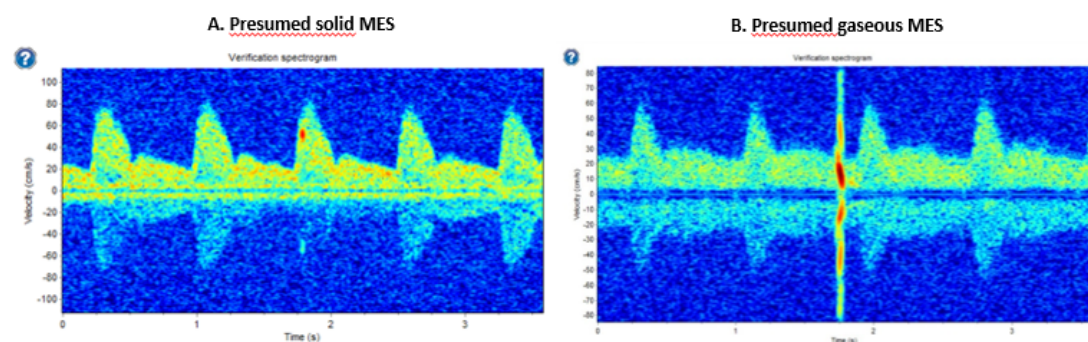
[1] Dept Cardiosurgery Haga Hospital, The Hague, Netherlands, [2] Software developer Gromers IC Gouda, [3] Stats Bergman Clinic, Naarden, Netherlands.

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Disclosure by Keunen: the Solid–Gaseous Embolus Classification Algorithm is exclusively distributed on Delica TCD systems as the Delica Solid–Gaseous Embolus Classification Algorithm.

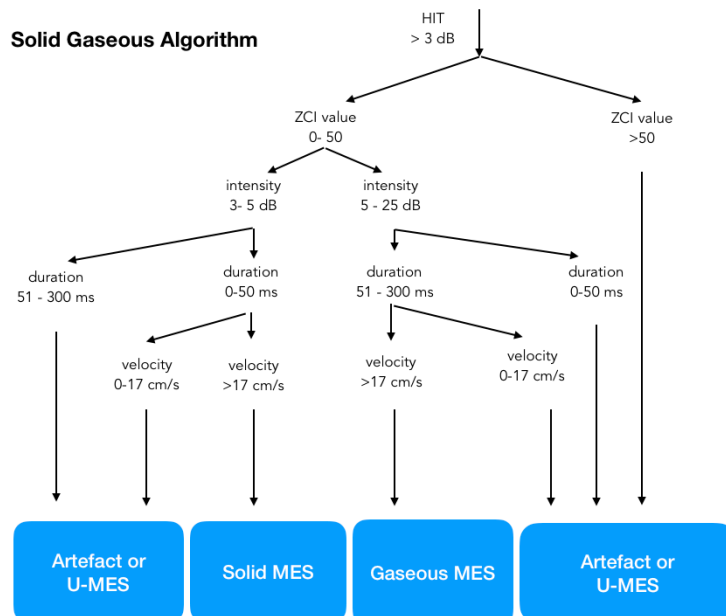
Background

Micro-embolic signals (MES) can be detected by transcranial Doppler (TCD), but data on their occurrence immediately after cardiac valve surgery remain limited. This study evaluated the incidence, characteristics, and clinical relevance of MES during the early postoperative period.



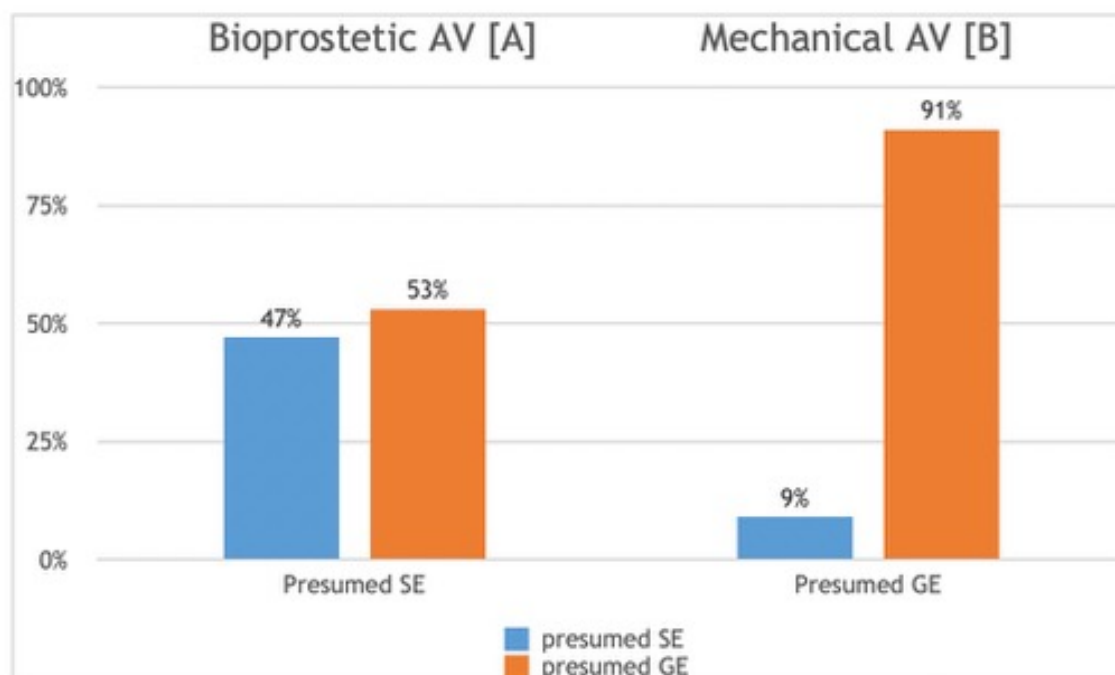
Methods

In this prospective single-center study, 93 patients (mean age 67 years; 83.9% male) undergoing aortic (AVS, n=70) or mitral valve surgery (MVS, n=23) between 2019 and 2022 were monitored using TCD during the first four postoperative hours. MES were identified and classified using a peer-validated solid–gaseous–artefact algorithm [see Reference 1 and decision tree below]. Associations between MES burden, embolus type, valve characteristics, and early postoperative outcomes were analyzed.



Results

Baseline preoperative recordings in 20 patients showed no MES except for one presumed solid embolus. Postoperatively, MES were detected in 85% of patients, with counts ranging from 1 to 88 per hour. Sixteen percent of patients exhibited a high MES burden (>20 /hour), predominantly after AVS. Overall, 43% of MES were classified as solid and 57% as gaseous. MES burden was significantly higher after AVS than MVS (48.5 vs 3.2 MES/hour; $p<0.005$). As seen in the graph below mechanical AVS was associated with a higher proportion of gaseous emboli than biological valves (gaseous/solid ratio 10.1 vs 1.1; $p<0.05$). Higher solid MES counts correlated with increasing age. Although patients with postoperative delirium tended to have higher MES loads, this association was not significant after age adjustment. Adverse events occurred in 9.7% of patients.



Conclusion

Micro-embolic signals are common in the early postoperative period after cardiac valve surgery. The application of a validated solid–gaseous embolus classification algorithm enabled structured interpretation of a large and complex Doppler dataset, revealing clinically relevant differences in embolus burden and composition related to valve type and patient age. While independent associations with early postoperative complications were limited, these findings highlight the value of detailed embolus characterization in understanding perioperative cerebral micro-embolization.

Reference

1. Keunen RWM, Daal SM, Romers GJ, Hoohenkerk GJF, van Kampen PM, Suyker WJL. Diagnostic Accuracy of an Algorithm for Discriminating Presumed Solid and Gaseous Microembolic Signals During Transcranial Doppler Examinations. *Ultrasound Med Biol*. 2023 Dec;49(12):2483-2488. doi: 10.1016/j.ultrasmedbio.2023.08.011. Epub 2023 Sep 13. PMID: 37709563.