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SHORT COMMUNICATION

Acute normovolemic hemodilution in cardiac surgery and the power of global collaboration in advancing research

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Abstract

Acute normovolemic hemodilution (ANH) is a blood conservation strategy in cardiac surgery aimed at reducing perioperative need for transfusion and preserving hemostatic function. While ANH has potential benefits, its global adoption remains heterogeneous and poorly characterized. To investigate current practice patterns, we conducted a rapid international survey among cardiac anesthesiologists, disseminated through the International Academy of Cardiac Anaesthesiologists (IACA) global network and the European Association of Cardiothoracic Anaesthesiology (EACTAIC). We reached specialists from 31 countries, with 28 providing responses: on average, 26.7% of cardiac anesthesiologists reported using ANH and 13.7% of cardiac surgery patients worldwide actually receive ANH, rising to 17.5% when considering a population-weighted mean. Notable regional variability was observed, ranging from 37.3% use in the Americas to just 5.0% in Oceania. These findings reinforce previous reports and underscore the ongoing global disparities in ANH implementation. Moreover, this study highlights the power of international collaboration in addressing knowledge gaps and establishing global benchmarks. By engaging national leaders and taking advantage of inter-societal cooperation, the survey not only provided meaningful insights but also demonstrated the feasibility of rapidly gathering global data on specific perioperative practices. Ultimately, this study lays the groundwork for multicenter research and calls for a large randomized international trial to definitively assess the clinical impact of ANH in cardiac surgery.

Keywords

Acute normovolemic hemodilution; Anesthesiology; Cardiac surgery; International survey; Transfusion

1. Main text

Perioperative bleeding is a common complication of cardiac surgery and accounts for approximately 15% to 20% of the total demand for blood transfusions within national blood supply systems [1]. While allogeneic red blood cell units are frequently employed to manage surgical bleeding [2], their transfusion has been consistently associated with worsened both short- and long-term clinical outcomes [1, 3]. Therefore, there is growing interest in patient blood management strategies, such as acute normovolemic hemodilution (ANH). ANH is a blood conservation technique used to preserve hemostatic function, reduce the need for blood transfusion and improve overall patient outcomes [4], and it allows the reinfusion of the patients' whole blood withdrawn before exposure to heparin and cardiopulmonary bypass (CPB) [5]. Nonetheless, its use varies significantly from country to country and there is ongoing debate on its effectiveness [6].

The International Academy of Cardiac Anaesthesiologists (IACA) (https://iacaworld.org/), established in 2025, is an international society whose members are not individuals, but national and regional societies in the field of cardiothoracic and vascular anaesthesiology and intensive care. IACA envisions a global collaboration of physicians dedicated to leadership in cardiothoracic and vascular anaesthesia and perioperative medicine. Its mission—"Enhancing the quality of global patient care and safety in cardiothoracic and vascular anaesthesia through collaboration in global education, quality improvement and research"—clearly reflects its overarching goal: to unite member societies and their leadership in pursuit of the highest standards of practice and patient safety across a range of disciplines, including cardiothoracic and vascular anaesthesiology, perioperative medicine, critical care medicine, perfusion techniques, ventricular assist devices, mechanical circulatory support, organ transplantation and transfusion medicine, through education, research and professional development.

Currently, IACA's members include the Society of Cardiothoracic Anesthesiologists (SCA), representing North America; the European Association of Cardiothoracic Anaesthesiology and Intensive Care (EACTAIC); and the Association for Cardiothoracic Anaesthesia and Critical Care (ACTACC) from the United Kingdom. Ten additional societies from five continents are in the process of joining IACA. This broad international representation will provide a strong and effective foundation for worldwide collaboration.

We conducted a cross-sectional international rapid online survey (**Supplementary material**) involving cardiac anesthesiologists worldwide to investigate the level of awareness and the use of ANH across different countries, based on the expertise of key opinion leaders. Data were collected using Google Forms (https://docs.google.com/forms/u/0/), a secure online platform. Two senior cardiac anesthesiologists reviewed the survey, which was disseminated on 27 April 2025, and remained open until 01 May 2025. Participation was entirely voluntary, and no financial remuneration was provided. This project was made possible through a truly collaborative approach. By distributing the survey link mainly through a network of trusted personal contacts, the EACTAIC national representatives, and—most notably—the Board of the IACA, we reached a diverse and representative cohort of specialists across continents.

The survey aimed at assessing the current use of ANH in cardiac surgery across different countries. We explored the proportion of cardiac anesthesiologists utilizing ANH in each country and the percentage of cardiac surgery patients actually receiving ANH in each country. Respondents selected predefined percentage ranges or indicate if they were unable to answer. The survey was designed to be completed rapidly. It was conducted in English, without translations. Dichotomus variables were reported as absolute numbers with corresponding percentages. Continuous variables were reported as mean. Missing data for each main question were documented, and no imputation methods were applied. All available responses were included in the analysis. The data were aggregated both overall and by continent.

We contacted 31 countries (Argentina, Australia, Austria, Brazil, Bulgaria, Canada, China, Croatia, Czech Republic, Egypt, France, Germany, Greece, Hungary, Italy, Malaysia, Mexico, New Zealand, Poland, Russia, Saudi Arabia, Singapore, South Africa, South Korea, Spain, Switzerland, Taiwan, Thailand, Turkey, the United Kingdom, the United States) and received 28 replies (we did not receive response from Argentina, Bulgaria and Canada). All participants were cardiac anesthesiologists. An average of 26.7% cardiac anesthesiologists worldwide are aware of and use ANH in some of their cardiac surgery patients. The number of patients receiving ANH worldwide was 13.7%, a percentage which raises to 17.5% when weighting for countries population. The distribution of this practice is heterogeneous across different continents, ranging from 37.3% in America to 5.0% in Oceania (Table 1, Fig. 1).

2. The power of global collaboration in advancing cardiac anesthesia research

In this rapid survey, we found that ANH is used by >25% of cardiac anesthesiologists worldwide and that 13–17% of patients undergoing cardiac surgery are receiving it. Furthermore, this global survey on the practice of ANH in cardiac surgery highlights how meaningful insights can emerge when borders are bridged, and expertise is shared. It clearly shows that scientific progress in perioperative care, particularly in specialized fields like cardiac anesthesia, increasingly depends on international cooperation.

The engagement of IACA deserves special recognition. As a unique global entity whose membership comprises national and regional societies rather than individuals, IACA embodies the spirit of collective advancement. Its support not only enhanced the survey's reach but also underscored the Academy's role as a conduit for international scientific dialogue. This collaborative model amplifies the voice of each society, facilitates consensus building, and strengthens the foundation for future multicenter research.

Notably, the results of this survey are in line and reinforce previous evidence in that ANH is used in the majority of countries worldwide and in approximately 15% of patients undergoing cardiac surgery [7]. Before conducting this survey, only limited data were available in the literature. Goldberg *et al.* [5] reported that 17% of patients in the United States underwent ANH. In a 2017 study by Stammers *et al.* [4], ANH combined with autologous priming was used in 19.9% of centers and 15.5% of patients across the United States. Zhou *et al.* [8] found that 27.8% of cardiac surgery patients in China received ANH. These findings underscore the variability in ANH use and the need for updated, internationally representative

TABLE 1. Global and regional distribution of acute normovolemic hemodilution (ANH) use in cardiac surgery.

	Mean percentage of cardiac anesthesiologists who use ANH in cardiac surgery	Mean percentage of cardiac surgery patients who actually receive ANH
Worldwide*	26.7%	13.7%
America	37.3%	22.7%
Africa	15.0%	5.0%
Asia	35.7%	15.7%
Europe	24.7%	13.2%
Oceania	5.0%	5.0%

**The reported means are arithmetic. ANH: acute normovolemic hemodilution.*

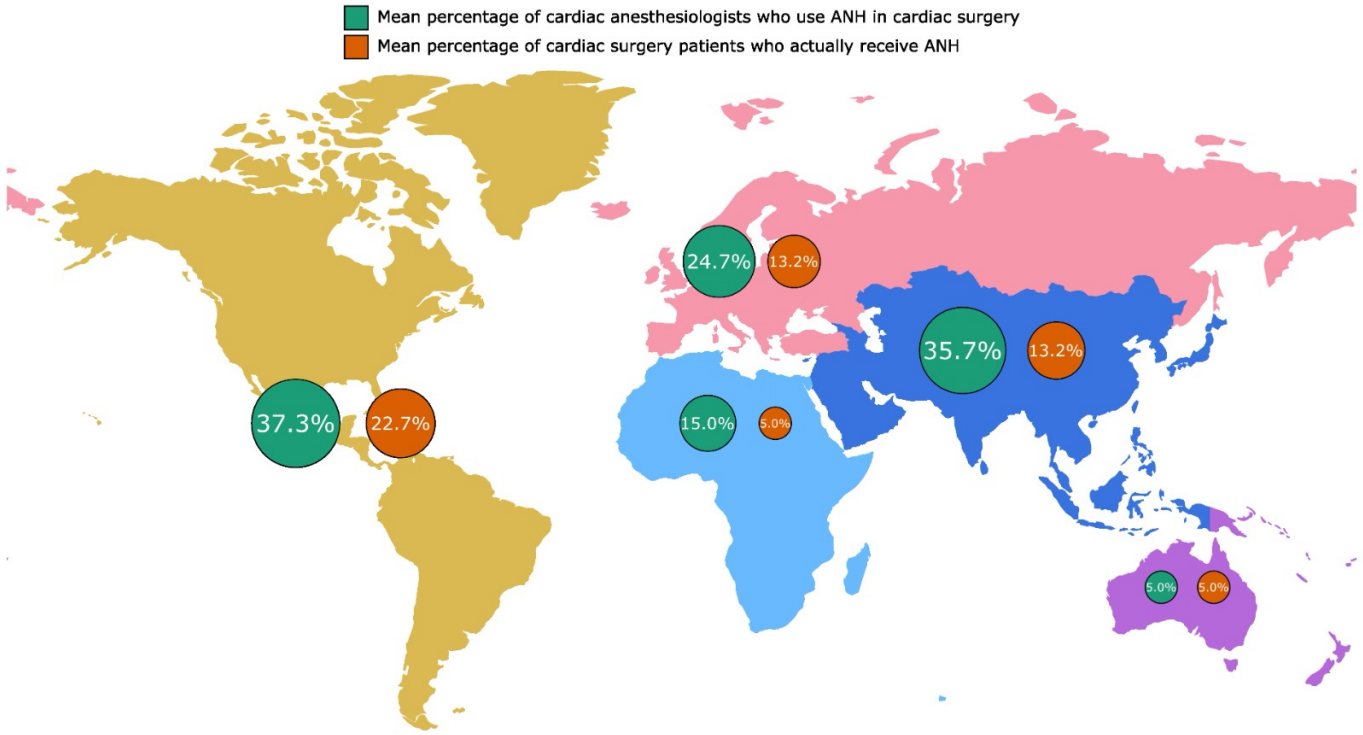

FIGURE 1. Worldwide patterns of acute normovolemic hemodilution use. Percentages of cardiac anesthesiologists who report using acute normovolemic hemodilution (ANH) in their practice (green), alongside the corresponding percentage of patients who actually receive ANH during cardiac surgery (orange).

data, which this survey aims to provide. This is particularly important for strategies which have a documented effect on the reduction in perioperative allogenic red blood cell transfusion [9]. Therefore, there is a need to determine whether ANH truly improves clinical outcomes through a large, randomized, international multicenter trial [6]. This survey also reveals how, by engaging key persons from national societies, it is possible to collect meaningful data in a short time frame, enabling the rapid identification of global practice patterns.

The success of this survey shows that the future of scientific inquiry in cardiac anesthesia lies in shared vision and unified efforts. This approach may help identify specific perioperative practices characterized by global variability, which could become priorities for further investigation. As we interpret the findings, let us also celebrate the process that made them possible and continue to foster a global community committed to excellence in patient care through research.

ABBREVIATIONS

ACTACC, Association for Cardiothoracic Anaesthesia and Critical Care; ANH, acute normovolemic hemodilution; CPB, cardiopulmonary bypass; EACTAIC, European Association of Cardiothoracic Anaesthesiology and Intensive Care; IACA, International Academy of Cardiac Anaesthesiologists; SCA, Society of Cardiothoracic Anesthesiologists.

AVAILABILITY OF DATA AND MATERIALS

The dataset generated and analyzed for this brief survey are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

FG and RL—designed the research study and wrote the first draft of the manuscript. MAB, RL and GP—performed the research; analyzed the data; reviewed and edited the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. Fabio Guarracino is serving as one of the Editorial Board members of this journal. We declare that Fabio Guarracino had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to JST.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found, in the online version, at https://oss.signavitae.com/mre-signavitae/article/1926887797913731072/attachment/Supplementary%20material.docx.

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