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European implementation of the “2014 ESC/ESA guideline on non-cardiac surgery: cardiovascular assessment and management”.*

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Summary:

Substandard implementation of a guideline is a major factor contributing to poor guideline adherence and has the potential to result in preventable patient harm. This study aims to quantify the uptake of the European guideline on non-cardiac surgery^{1,2} by European anaesthetists. Data for this questionnaire-based cross-sectional study was collected during Euroanesthesia, the annual congresses of the Dutch Society of Anaesthesiology, European Association of Cardiothoracic Anaesthesiologists and European Society for Regional Anaesthesia 2015. Primary endpoints were the implementation and knowledge scores derived from the questionnaires. The implementation score from 488 questionnaires was excellent in 4%, good in 14%, average in 22%, poor in 32% and very poor in 28% of the cases. The knowledge score was excellent in 1%, good in 27%, moderate in 49%, poor in 18% and very poor in 5% of the cases. Current implementation and knowledge of the guideline on non-cardiac surgery in Europe needs to be improved.

Introduction:

In October 2014 The Joint Task Force on non-cardiac surgery from the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA) published a revision of the ESC/ESA guideline on non-cardiac surgery: cardiovascular assessment and management on the basis of current evidence.^{1,2} Cardiovascular comorbidity is a frequently encountered problem in the surgical population and carries a significant risk of increased complications. Its incidence is furthermore expected to rise in the coming years.¹ In order to reduce perioperative complications from cardiovascular comorbidities, it is important that patients receive standardised care according to best practice and guidelines are key in this. Although adherence to guidelines enhances treatment outcomes, both knowledge of, as well as compliance with the guidelines is often suboptimal in clinical practice.³ Recent studies showed that fewer than half of the anaesthetic consultants and trainees correctly apply the standard of care for the perioperative cardiac evaluation.^{4,5} Good implementation of a guideline can augment compliance. It is therefore a key challenge for policymakers and health-care professionals to ensure sound implementation of critical guidance. Faced with the task of implementing the revised guideline,¹ the ESA/ESC taskforce published the guideline in well-read scientific journals of the target specialties^{1,2} and as an open access online version. They also created a number of implementation tools such as condensed pocket versions, booklets, summary cards and slides to further disseminate and promote knowledge of the guideline. National societies for cardiology and anaesthesiology from all European countries were encouraged to endorse, translate and implement the guideline in their respective countries. However, no data are currently available regarding the implementation of this guideline in clinical practice.

Based on previous studies³⁻⁵ we hypothesised that – despite all effort taken to improve implementation - the current implementation of the ESC/ESA guideline on non-cardiac surgery: cardiovascular assessment and management^{1,2} by anaesthesiologists throughout Europe is still suboptimal. The aim of this study is to quantify the current uptake of this guideline by European anaesthesiologists.

Methods

This study did not necessitate ethical approval. A two-part questionnaire was developed and validated to describe the implementation practices of the ESC/ESA guideline on non-cardiac surgery in Europe. The questionnaire can be found in the appendix. The first part of the questionnaire focused on the implementation strategies used in departments to implement the guideline. The National Institute for Health and Care Excellence (NICE) has a proven track record of successful implementation of guidance. Based on their experience, The NICE emphasizes that there are several elements to successful implementation of guidelines.⁶ The implementation part of the questionnaire was based on these items: whether there were any notifications in the department regarding the guideline, whether there is board support and clear leadership regarding the implementation of new guidelines in general, whether there is a designated person who drives the implementation of this guideline in the department, if there were any plenary and multidisciplinary meetings or lectures regarding the changes in this guideline and whether any existing protocols regarding the pre-operative assessment of patients with cardiovascular morbidity, the management of patients with non-vitamin K antagonist oral anticoagulants (NOACs) or new generation drug eluting stents (DES) were drafted. Anaesthesiologists were also asked to rate on a Likert scale, how well they felt that the guideline was implemented in their department with 1 = strongly disagreeing and 5 = strongly agreeing with good implementation. The second part of the questionnaire focused on knowledge of the content of the guideline by European anaesthetists. Twenty-four statements were formulated based on the guideline.¹ For 12 questions, recommendations regarding the clinical management had changed from the previous version of the guideline and for the other 12 questions the recommendations had remained the same as in the previous guideline published in 2009.^{7,8}

A score was generated for both the implementation and knowledge part of the questionnaire. For the implementation part, there were 9 items that could be scored with yes (1 point), no (0 points) or don't know (0 points). The total implementation score was categorized into 5 categories excellent (8-9 points), good (6-7 points), average (4-5 points), poor (2-3 points) and very poor (0-1 points). The knowledge part consisted of twenty-four questions that could be answered with true, false or don't know. One point was awarded for a correct answer and no points for an incorrect or ignorant answer. This score was categorized into excellent (20-24 points), good (15-19 points), average (10-14 points), poor (5-9 points) and very poor (0-4 points).

Content validity of the questionnaire was established by expert review. A member of the ESA Joint taskforce on non-cardiac surgery and ESA Clinical Guideline Committee was invited to review the questionnaire. A further 13 independent consultant anaesthetist from different nationalities and 4 trainees with a background in research and questionnaires also reviewed the questionnaire to determine whether the questions were clear. The questionnaire was finalised after this review process. Anaesthetists attending the 2015 Congress of the Dutch Society of Anaesthesiology, Euroanesthesia 2015, the annual meeting of the European Association of Cardiothoracic Anaesthesiologists (EACTA) 2015 and of the European Society for Regional Anaesthesia and Pain Therapy (ESRA) 2015 were asked to voluntarily and anonymously complete the questionnaire without consulting the guideline.

Statistical analysis was performed with IBM SPSS Statistics for Macintosh, Version 22.0. Armonk, NY: IBM Corp 2013. A Principal Components Analysis and Cronbach's Alpha were performed on the questionnaire to test internal validity of the questionnaire on the first sample of 107 questionnaires, collected at the 2015 Congress of the Dutch Society of Anaesthesiology. Cronbach's alpha was 0.8 indicating a good level of internal consistency for both the implementation scale and the knowledge part. Therefore, the decision was made to continue with this questionnaire and to include the data of this pilot sample in the overall study data. Data was assessed for normal distribution with histograms. Data are reported as mean (M) and standard deviation (SD) or median and interquartile range (IQR). Chi square test for trend was used to test categorical data. Linear regression analysis was performed to test the relationship between the implementation and knowledge score. The Wilcoxon signed rank test was used to test the differences between new and continued recommendations. A P-value of < 0.05 was considered statistically significant.

Results

A total of 504 questionnaires were collected. After exclusion of partly filled in questionnaires and questionnaires filled in by doctors practicing in countries beyond the scope of application of ESA guidelines such as America, Australia or China, 488 questionnaires remained for analysis. Cronbach's alpha for all 488 questionnaires was again 0.8 for both the implementation scale and the knowledge part indicating a good level of internal consistency. Three hundred twenty-six (68%) respondents were anaesthetic consultants and 155 (32%) respondents were residents. Hospital backgrounds of the participants were an academic hospital in 230 cases (47%), a teaching hospital in 149 cases (30%), a district general hospital (DGH) in 101 (21%) and other, mainly private, in 8 cases (2%). Amongst the respondents 44 (9%) had not heard of the guideline before. Most anaesthesiologists had found out about the guideline through the internet (35%), by the European Journal of Anaesthesiology (30%) or through colleagues (16%).

Implementation

The implementation score was excellent in 4% (n=19), good in 14% (n=69), average in 22% (n=109), poor in 32%(n=154) and very poor in 28% (n=137) of the cases. Overall scores for specific implementation items can be found in table 1. The results of the implementation versus the self-assessment of implementation by European anaesthetists can be found in figure 1. There was a significant difference in implementation scores between the different hospital settings. In a trend wise manner, academic hospitals scored the highest with a median of 3 (IQR 2-5[0-9]); followed by teaching hospitals with a median of 3 (IQR 1-4) followed by DGHs with a median of 3 (IQR 1-4) followed by private hospitals with the lowest implementation score with a median of 2 (IQR 1-2) $p < 0,001$. Because of the variation in number of questionnaires from each country, country-by-country comparison was not possible. Scores from countries with more than 10 participants are summarised in table 2. Russia and the Netherlands had the highest implementation scores of a median of 5 (IQR 5-7) and 4 (IQR 2-6), respectively. The United Kingdom had the lowest implementation score with a median of 1 (IQR 0-3) followed by Switzerland with a median of 1,5 (IQR 1-4). Countries that had the highest scores for knowledge were France (M 15 \pm SD 2) and Poland (M 15 \pm SD 4). The lowest knowledge score was observed for the United Kingdom (M 11 \pm SD 5).

Knowledge

The mean overall score for correct answers was 15 with a SD of 5. Categorised scores of participants can be found in figure 2. Detailed information about percentages of (in)correct answers can be found in the supplementary appendix. In general, the questions regarding anticoagulant management had the highest percentage of incorrect answers. When comparing knowledge from the guideline regarding new management and continued recommendations, respondents scored significantly higher on the questions that referred to clinical management continued from the previous guideline (figure 3) $p < 0,0001$. Again in a trend wise manner there was a significant difference in knowledge scores between the different hospital settings; academic hospital had the highest scores of (M 15,4 \pm SD 4); followed by teaching hospitals (M 15 \pm SD 5) and private hospitals (M 14,4 \pm SD 4). DGHs scored the lowest with (M 13,9 \pm SD 5). $p = 0,02$. There was no significant difference in the knowledge score between anaesthetists attending the different conferences: Euroanesthesia (M 16 \pm SD 5); EACTA (M 16 \pm SD 5); ESRA (M 14 \pm SD 5) and the annual conference for the Dutch Society for Anaesthesiology 2015 (M 15 \pm SD 5) $p = 0,2$. There was also no significant difference in knowledge of the content of the guideline between consultants or residents (both M 15 \pm SD 5) $p = 0,13$. Regression analysis revealed a significant relation between the implementation score and the knowledge score with a B value of 0,45 with a 95% CI [0.27-0.64]. $p < 0,0001$. Indicating that an increase of 1 point in implementation score will improve the knowledge score with 0,45 points.

Discussion

Implementation

We assessed the implementation of the ESC/ESA guidelines on non-cardiac surgery in Europe. We found that only 18% of the questionnaires amounted to a good implementation score and a distressing 60% to a poor implementation score. In view of the real threat that cardiovascular comorbidity poses for patients in the perioperative period, implementation of this guideline needs to be improved. This study shows that academic hospitals have taken significantly more steps to implement this guideline. Which is what we would expect as a larger proportion of complex patients will be treated here and hence, there will be a greater incentive for the implementation of this guideline. Moreover, doctors in an academic hospital will probably have more affinity with recent developments in the literature than doctors in a DGH or private hospital. When comparing the implementation scores and the self-assessment of implementation, anaesthetists tend to overestimate the implementation practices of their department as can be seen in figure 1. Almost 1 in 5 anaesthesiologists indicated that they did not know whether their departments had taken steps to implement the guideline. This means either a lack of clear communication from policy makers and/or a lack of engagement of staff with implementation policies of their department.

Consequently, policy makers need to convey a very clear implementation strategy and actively engage staff in this process in order to improve implementation. However, as much as it is the responsibility of the ESC/ESA taskforce, anaesthetic scientific organisations and departments to improve their implementation strategy, it is also the responsibility of individual anaesthetists to improve the implementation of this guideline in their departments in order to ensure best practice management, and therefore better outcomes, for their patients. Although the limited number of participants from certain countries did not allow statistical comparisons between countries, it is likely that the low implementation score of the United Kingdom is meaningful. Because the National Institute of Clinical Excellence produces guidelines for England and Wales it is possible that there is less emphasis on European guidelines in the United Kingdom. It might be worth considering close liaison with the National Institute of Health and Care Excellence when policy makers endeavour optimal implementation of European Guidance in the United Kingdom. This study also emphasizes a lack of multidisciplinary engagement, as this item had the lowest score on the implementation scale. Within the current complex clinical environment, a multidisciplinary approach to patients with cardiovascular comorbidity is vital to prevent perioperative complications. All disciplines involved, i.e. surgery, anaesthesiology, cardiology

and haematology, should agree on how to incorporate this guidance into local protocols in their hospital. We feel that anaesthesiologists, as perioperative physicians, should take the lead in coordinating these efforts to ensure uniform operating procedures within the hospital. Patients scheduled for non-cardiac surgery are furthermore likely to be admitted under the surgical service of a hospital, making surgery the overall responsible speciality. Taking this into account, it is surprising that no non-cardiac surgeon contributed to development of the guideline. This can partly be attributed to the absence of a representative common European surgical scientific society. The fact that the guideline also wasn't published in a surgical journal could furthermore contribute to a lack of support and therefore lack of knowledge of the guideline by surgeons. This could result in a decreased adherence rate to best practice perioperative management, and subsequent potential patient harm. We therefore suggest to include representatives from non-cardiac surgical scientific societies in the Task Force for future revisions of this guideline and to additionally publish the guideline in a surgical journal. Finally, another problem with the implementation of this guideline is that there are at least 3 international guidelines^{1,9,10} for the assessment and management of the perioperative cardiovascular compromised patient. Having several guidelines promotes ambiguity and confusion in the user as to which one to apply. Since every guideline has to be made applicable to the national situation anyway, it might be advantageous to have only one international guideline with coordinators on a national level to translate and apply the guideline to the local situation.

Knowledge

The second part of the questionnaire focused on knowledge that European anaesthetists had of the content of the guideline from the top of their head. European anaesthetists were significantly less familiar with new recommendations of the 2014 guidelines compared with recommendations that had remained the same from the previous version of the guideline.^{7,8} This study also found that knowledge scores were significantly better with increasing implementation scores, i.e. when implementation of the guideline was done better. Our data show that in 72% (figure 2) of the cases, European anaesthetist scored moderate to very poor for their knowledge of the content of the guideline from the top of their head. Numerous studies corroborate that healthcare professionals forget steps in the management of patients if they treat patients from memory alone.¹¹⁻¹³ It is therefore vital to be able to consult the guideline at times when appropriate arrangements for patients need to be made, for example in the outpatient clinic. From this sample however, 30% of doctors

stated that they were not able to consult the guideline during outpatient clinic. However, it is questionable whether this is actually true as any device with an Internet connection will be able to provide access to the open access publication of the guideline. In fact, this could hint to suboptimal implementation again, as a significant proportion of doctors apparently seem unaware how to find these guidelines, when in fact they are easily and freely accessible. However, even if the full version of the guideline could be found during clinical consultations, it is unlikely that time pressure will allow comprehensive examination of this 49-page guideline.^{1,2} The combination of inadequate knowledge of the guideline and the difficulty in consulting the guideline when arrangements need to be made is likely to cause a decreased adherence rate to best practice management and subsequent preventable patient harm¹³ and is, therefore, extremely undesirable. This study identified a particularly risk for perioperative anticoagulant mismanagement as questions regarding the anticoagulant management had the highest percentage of incorrect answers. Local protocols, cognitive aids and/or electronic decision support tools can make a significant difference in ease to consult and correctly apply the guidelines in the outpatient clinic and so, improve adherence to best practice and reduce costs.¹⁴ These tools should therefore be integrated in clinical practice.

Limitations

One of the limitations of this study is that selection bias might have occurred. Participants that filled out the questionnaires were attendees of scientific conferences and participation was voluntary. This could have led to overrepresentation of more implementation-engaged and scientific up-to-date anaesthetists, probably leading to higher scores in the knowledge part. To correctly interpret the knowledge score, it is important to mention that, apart from not knowing the correct answer, participants could also have answered questions incorrect because they misinterpreted the question, either due to poor attention or because of the phrasing of the question. However, during validation of the questionnaire, doctors from several nationalities reviewed the questions to prevent misinterpretation because of phrasing. In addition, one member of our research team was always available to answer questions while participants completed the questionnaire. Furthermore, most questions were statements directly taken from the guideline. If questions were misinterpreted because of the phrasing, then it is likely that these doctors would also misinterpret the guideline. It is lastly important to recognise that the results of this questionnaire do not necessarily reflect true implementation practice of hospitals across Europe; rather it reflects

the perception of implementation of this guideline by anaesthesiologists. However, these anaesthesiologists are the ones involved in the practical conduct of anaesthesia on a daily basis, which means that, even if these implementation steps are actually taken by a department, the lack of knowledge by the respective anaesthetists still indicates suboptimal implementation.

Conclusion

Implementation of the ESC/ESA guideline for non-cardiac surgery needs to be improved. In a synergistic way, policy makers and head of departments should improve participation of staff in the implementation process of guidelines and anaesthetist should take more responsibility themselves for better implementation of guidelines. Knowledge of the content of the guideline with particular regard to the perioperative anticoagulant management in these cardiac patients is poor amongst anaesthetist. To ensure adherence to best practice perioperative anticoagulant management, and adherence to this guideline in general, local protocols, cognitive aids and/or decision support should be integrated in clinical practice.

Competing interests

Prof. S de Hert is a member of the ESA Joint taskforce on non-cardiac surgery. No external funding and no competing interests declared for all authors.

Appendices

Questionnaire European implementation of the 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management, with percentages of correct and incorrect answers.

References

1. The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management. *European Journal of Anaesthesiology* 2014; 31(10): 517-73.
2. The Joint Task Force on non-cardiac surgery: cardiovascular assessment and management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA). 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular assessment and management. *European Heart Journal* 2014; 35: 2383–2431.
3. Hoeks SE, Scholte op Reimer WJ, Lenzen MJ, van Urk H, Jörning PJ, Boersma E, Simoons ML et al. Guidelines for cardiac management in noncardiac surgery are poorly implemented in clinical practice: results from a peripheral vascular survey in the Netherlands. *Anesthesiology* 2007; 107: 537– 44.
4. Vigoda MM, Sweitzer B, Miljkovic N, Arheart KL, Messinger S, Candiotti K, Lubarsky D. 2007 American College of Cardiology/American Heart Association (ACC/AHA) Guidelines on perioperative cardiac evaluation are usually incorrectly applied by anesthesiology residents evaluating simulated patients. *Anesthesia & Analgesia* 2011; 112:940–9.
5. Vigoda MM, Behrens V, Miljkovic N, Arheart KL, Lubarsky DA, Dutton RP: Perioperative cardiac evaluation of simulated patients by practicing anesthesiologists is not consistent with 2007 ACC/AHA guidelines. *Journal of Clinical Anesthesia* 2012; 24:446–55.
6. National Institute for Health and Clinical Excellence. How to put NICE guidance into practice. A guide to implementation for organisations. Downloaded from <http://www.lumsa.it/sites/default/files/UTENTI/u492/nice.pdf> February 2015.
7. The Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery of the European Society of Cardiology (ESC) and endorsed by the European Society of Anaesthesiology (ESA). Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery. *European Journal of Anaesthesiology*. 2010; 27: 92-137.
8. The Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery of the European Society of Cardiology (ESC)

and endorsed by the European Society of Anaesthesiology (ESA). Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery. *European Heart Journal* 2009; 22: 2769–2812.

9. Fleisher LA, Fleischmann KE, Auerbach AD, Barnason SA, Beckman JA, Bozkurt B, Davila-Roman VG et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines. *Journal of the American College of Cardiology* 2014; 64: e77.
10. Douketis JD, Spyropoulos AC, Spencer FA, Mayr M, Jaffer AK, Eckman MH, Dunn AS et al. Perioperative Management Of Antithrombotic Therapy. *Chest* 2012; 141(2_suppl): e326S-e350S. doi: 10.1378/chest.11-2298.
11. Arriaga AF, Bader AM, Wong JM, Lipsitz SR, Berry WR, Ziewacz JE, Hepner DL et al. Crisis checklists for the operating room: development and pilot testing. *New England Journal of Medicine* 2013; 368: 246-53.
12. Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AS, Dellinger EP, Herbosa T et al; Safe Surgery Saves Lives Study Group. A surgical safety checklist to reduce morbidity and mortality in a global population. *New England Journal of Medicine*. 2009; 360: 491-9.
13. Hand WR, Bridges KH, Stiegler MP, Schell RM, DiLorenzo AN, Ehrenfeld JM, Nietert PJ et al. Effect of a cognitive aid on adherence to perioperative assessment and management guidelines for the cardiac evaluation of noncardiac surgical patients. *Anesthesiology* 2014; 120: 1339–49.
14. DeSancho MT, Bardarova S, Chapin J. Adherence to guidelines for perioperative management of anticoagulation results in decreased bleeding complications: a single-centre experience. *Blood Coagulation & Fibrinolysis* 2015, 26: 426–9.

Table 1 Implementation items. Values are number (proportion) of participants.

| Implementation item | Yes | No | Don't know |
|--|-----------|-----------|------------|
| Notifications in the department | 126 (26%) | 284 (58%) | 78 (16%) |
| Board support and Clear leadership | 173 (35%) | 239 (49%) | 76 (16%) |
| Designated person driving implementation | 127 (26%) | 284 (58%) | 77 (16%) |
| Plenary meeting | 153 (31%) | 281 (58%) | 54 (11%) |
| Multidisciplinary meeting | 75 (15%) | 339 (70%) | 74 (15%) |
| Change protocol preoperative assessment | 169 (35%) | 236 (48%) | 83 (17%) |
| Change protocol non-vitamin-K-antagonist oral anticoagulants | 223 (46%) | 197 (40%) | 68 (14%) |
| Change protocol Drug Eluting Stent | 170 (35%) | 230 (47%) | 88 (18%) |
| Availability guideline at outpatient clinic | 339 (70%) | 65 (13%) | 84 (17%) |

Table 2 Implementation and knowledge score of participants from different European countries with more than 10 participants, in alphabetical order. Values are mean (SD), median (IQR [range]) or number.

| Country | Implementation score | Knowledge score |
|--------------------------------|-----------------------------|------------------------|
| Belgium (<i>n</i> =26) | 3 (2-4 [0-9]) | 13 ± 4 |
| France (<i>n</i> =13) | 3 (1-5 [0-7]) | 15 ± 4 |
| Germany (<i>n</i> =33) | 3 (1-5 [0-7]) | 14 ± 4 |
| Italy (<i>n</i> =18) | 2 (1-4 [0-6]) | 10 ± 4 |
| Netherlands (<i>n</i> =145) | 4 (2-6 [0-9]) | 12 ± 2 |
| Poland (<i>n</i> =11) | 2 (1-5 [0-9]) | 15 ± 2 |
| Portugal (<i>n</i> =24) | 2,5 (1-5 [0-7]) | 13 ± 3 |
| Russia (<i>n</i> =11) | 5 (5-7 [4-9]) | 12 ± 4 |
| Spain (<i>n</i> =20) | 2,5 (1-5 [0-7]) | 13 ± 5 |
| Switzerland (<i>n</i> =22) | 1,5 (1-4 [0-6]) | 14 ± 4 |
| Turkey (<i>n</i> =11) | 3 (1-7 [0-9]) | 12 ± 3 |
| United Kingdom (<i>n</i> =55) | 1 (0- 3 [0-9]) | 11 ± 5 |

Figures:

Figure 1 Implementation score (▣) versus self-assessment of implementation (□) within department (n=488).

Figure 2 Knowledge score. Excellent (20-24 points), Good (15-19 points), Average (10-14 points), Poor (5-9 points), Very poor (0-4 points) (n=488).

Figure 3 Differences in knowledge score between continued recommendations and new recommendations from previous version of the guideline for non-cardiac surgery. Box plots indicate the median and 25th and 75th percentiles. Whiskers indicate the 5th and 95th percentiles (n=488) (Wilcoxon signed rank test $p < 0,0001$).