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Two years after guidelines 2005: where are we now?

It is an honour to be invited to write this editorial, which accompanies the 10th anniversary edition of Notfall + Rettungsmedizin. Before addressing resuscitation guidelines, I would like to offer my congratulations on the formation of the Deutscher Rat für Wiederbelebung – German Resuscitation Council (GRC) on 12 December 2007. This very important development was achieved as a result of the considerable efforts by several individuals, in particular Burkhard Dirks, Hans-Richard Arntz, Jan Bahr and Uwe Kreimeier. By having a single organisation representing the views of health care professionals from a variety of disciplines it will be easier to standardise and implement national resuscitation guidelines and training courses. A single, cohesive organisation has a better chance of influencing laypeople, health care professional training organisations, and government departments.

The 2005 cardiopulmonary resuscitation consensus on science

The science reviews prepared for the 2005 Consensus Conference on Cardiopulmonary Resuscitation (CPR) Science and Treatment Recommendations (CoSTR) were comprehensive and well structured [28] and the process was accompanied by a strictly enforced policy to manage potential conflicts of interest [10]. The output from this conference provided the scientific background to the European Resuscitation Council (ERC) Guidelines that were written and published in the same year [1, 29]. Other international resuscitation organisations, such as the American Heart Association (AHA), also derived their guidelines from the CoSTR [4]. In this issue of Notfall + Rettungsmedizin, the main changes to the 2005 ERC Guidelines are reviewed and their implementation

in Germany is discussed. What has been achieved internationally since the publication of the 2005 ERC Guidelines?

Quality of CPR

During the 2005 CoSTR conference there was general agreement about the need for increased emphasis on the quality of CPR, particularly the quality and number of chest compressions provided and the need to minimise interruptions in chest compressions. This was a strong theme throughout the conference and was reflected in the guidelines of all international resuscitation organisations [4, 19]. The ability to monitor the quality of CPR using automated external defibrillators (AEDs) that have been modified to record chest compression depth and rate, and ventilation, has demonstrated that CPR is often of poor quality both in and out of hospital [2, 39]. Excessive ventilation rates are common during CPR and the increase in intrathoracic pressure reduces blood flow generated by cardiac compressions [7, 6]. The latest models of these AEDs incorporate feedback systems that enable the quality of CPR to be both monitored and improved [24, 3]. The feedback provided by these devices during CPR enables rescuers to ventilate the lungs at the correct rate [3]. We await data to show whether or not these feedback systems actually improve survival.

Compression-ventilation ratio

During the 2005 CoSTR conference, controversial topics generally reflected either lack of data or contradictory data [31]. The optimal compression-ventilation (CV) ratio for CPR is unknown and was discussed at great length. Interruption of chest compressions to enable interventions such as ventilation reduces coronary and carotid perfusion pressure

and reduces the probability of defibrillation success [8, 5, 13]. It was eventually decided to change the recommended CV ratio from 15:2 to 30:2 so that the number of interruptions would be reduced and more compressions would be delivered in each minute [19, 31].

— **Two years on, we are still waiting for data to show whether this change in CV ratio changes outcome.**

Firefighters from Pittsburgh, using a CV ratio of 30:2 instead of 15:2 delivered more compressions each minute, but this did not increase the rate of return of spontaneous circulation (ROSC) [21].

Compression-only CPR

During the 2005 CoSTR conference, some experts advocated compression-only CPR for sudden, witnessed collapse. Compression-only CPR was incorporated to a limited extent in the 2005 ERC Guidelines: it was recommended only when a bystander was unable or unwilling to provide rescue breathing (mouth-to-mouth ventilation). Two years later, there is increasing evidence to suggest that in many cases rescue breathing has either no, or even an adverse, impact on outcome. At least five observational studies show similar survival rates when bystanders deliver compression-only CPR instead of conventional CPR [38, 37, 36, 23, 11].

In all these studies, any CPR was associated with a higher survival rate compared with no CPR. Although compression-only CPR was not associated with statistically higher survival rates overall compared with conventional CPR in any of the studies, a multivariable logistic regression analysis of the data from one of the studies resulted in an adjusted odds ratio of 2.22 (95% confidence interval 1.17–

4.21) for favourable neurological outcome at 30 days, indicating a significantly better outcome in the compression-only group [36].

The three most recent studies have been accompanied by editorials calling for an urgent change in CPR guidelines [16, 17]. The interpretation of observational studies such as these is fraught with difficulties because of the strong possibility of undetected confounders. After asphyxial cardiac arrest rescue breathing is likely to be essential if the victim is to have any chance of survival. The International Liaison Committee on Resuscitation (ILCOR) is undertaking a thorough review of the science underpinning compression-only CPR and will determine whether an advisory statement is required before the next CoSTR conference in 2010.

Defibrillation strategy

There were several changes to the advanced life support (ALS) guidelines in 2005. The most significant of these was a change from the use of three stacked shocks to a single-shock defibrillation strategy. The aim of this was to reduce the interruption to chest compressions. Delivery of a single shock is followed by immediate resumption of CPR without stopping to feel for a pulse or to check the rhythm. The CPR is continued for 2 min before a rhythm check is undertaken – unless the patient shows obvious signs of ROSC before this. This revision to the guidelines has resulted in a profound change in practice, but has this improved survival after cardiac arrest?

One observational study with an historical control group showed an increase in survival to hospital discharge following the introduction of a single-shock strategy [34]. This study incorporated a CV ratio of 15:2 instead of 30:2 because it was undertaken before the new guidelines were published. One of a few differences between the ERC and AHA Guidelines is that the AHA advocates continuing chest compressions during charging of the defibrillator but the ERC does not. As the evidence accumulates for reduced chances of successful defibrillation with pauses in chest compressions of just a few seconds [12] it appears that the AHA has probably got it right!

Cardiocerebral resuscitation

Investigators from the Sarver Heart Center in Arizona, USA have introduced the concept of

‘cardiocerebral resuscitation’ (CCR) for out-of-hospital cardiac arrest [14]. Tracheal intubation is delayed until 3 cycles of 200 compressions and rhythm analysis have been completed – during this time an oral airway is inserted and oxygen is given by a non-rebreather face mask, enabling passive delivery of oxygen during compressions [20]. If the initial rhythm is ventricular fibrillation (VF), 200 chest compressions are given before the first shock, followed by 200 post-shock chest compressions. Ventilation is included in the CCR strategy but it is de-emphasised in comparison with conventional CPR. The investigators have reported an increase in survival to hospital discharge from 3.6 to 9.2% for all cardiac arrests and from 10.9 to 28.1% for witnessed VF arrests (presented at the AHA Resuscitation Science Symposium (ReSS), Orlando, FL, November 2007).

Once again, we are challenged by having to interpret the results of studies that use historical controls. Those advocating the CCR technique believe strongly that it should be accommodated in revised guidelines [15].

Drugs

To some extent, the 2005 guidelines reduced the emphasis on drugs in advanced life support: in VF, adrenaline is delayed until just before the third shock and amiodarone is given even later – just before the fourth shock. Two years later, we still lack the data to show whether adrenaline influences outcome in human cardiac arrest. An ongoing study in Norway will hopefully address this issue. The evidence for giving amiodarone remains relatively weak: the only supportive data are for short-term survival [25].

One of the major practical problems with implementation of the ALS algorithm has been the precise timing of adrenaline administration. After considerable debate, the ERC ALS Working Party decided that on the VF side of the algorithm, adrenaline should be given just before the third shock. However, it is important that the shock is not delayed just to give the adrenaline and there have been some problems (at least in the UK) with implementing this. In Norway, chest compressions are stopped briefly to enable a rhythm check 1 min after shock delivery – adrenaline is given if VF is still present and compressions are then resumed for a further 2 min. This probably works bet-

ter than the ERC guideline but it is dependent on periods of chest compressions between shocks of 3 min instead of the 2 min recommended by ILCOR and by the ERC Guidelines.

▶ The AHA recommends the use of vasopressin as an alternative to adrenaline

One of the most significant differences between the AHA and the ERC Guidelines is that the AHA recommends the use of vasopressin as an alternative to adrenaline: it can be given instead of the first or second dose of adrenaline [4]. The ERC ALS Working Party decided not to recommend the use of vasopressin until more convincing data are available. Since the 2005 CoSTR there are few new data on the clinical use of vasopressin in CPR [41].

Post resuscitation care

The 2005 ERC Guidelines included a revised chain of survival [30]. The changes were in the first ring, which emphasised the prevention of cardiac arrest, as well as calling for help, and in the last ring, which now depicts post resuscitation care. Interest in post resuscitation care has increased sharply over recent years. The discovery that mild hypothermia can improve outcome for comatose survivors of VF cardiac arrest has been largely responsible for this increase in clinical interest [22, 9, 32]. Implementation of therapeutic hypothermia has been slow in Germany [40], as it has been in other parts of the world [26, 27] but it is my impression that, at least in the UK, there has been a dramatic increase in use over the last 2 years. The post cardiac arrest syndrome (PCAS) is now recognised as a clinical entity and a scientific review of this topic will soon be published by ILCOR and the AHA [35]. Treatment of the PCAS requires multiple interventions that all have to be implemented if survival is to be optimised [33].

Knowledge gaps

There are still significant gaps in our knowledge about the best treatment for cardiac arrest, both in and out of hospital, and these are discussed by Hans-Richard Arntz in this issue of *Notfall + Rettungsmedizin*. These knowledge gaps were collated during the

2005 CoSTR conference and have been published recently [18]. This document should help to stimulate studies that can be used to inform future CPR guidelines.

Outcome

Finally, what evidence do we have that the 2005 guidelines have been implemented and are improving survival from cardiac arrest? Some of the papers in this issue cover implementation of the guidelines in Germany. There are few published studies on implementation of the guidelines in general – this is not surprising given the time it takes to bring about change and then wait long enough to be able to analyse the effect on long-term outcome. Several abstracts presented at the AHA ReSS meeting in Orlando, FL in November 2007 suggested improving outcome from out-of-hospital cardiac arrest. These were generally observational studies comparing outcome with historical controls. It is difficult to know what treatment change has generated the improved outcome – multiple factors may be influencing the results.

The academics will be perplexed by not knowing which interventions work and which do not. The more pragmatic clinicians will argue that it does not matter as long as outcome is improving. The next consensus conference on CPR science, which will be held in Dallas in 2010, will enable clinicians and academics to debate the good science and the less good science. The consensus they reach will provide the basis for revised CPR guidelines throughout the world.

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Conflict of interest. I was a lead author of the 2005 ERC Guidelines.

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