Making increased compression time effective: a role for the CPREzy

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Introduction and background:

The guidelines 2005 express an unambiguous message: more compressions. (1)
However, the emphasis on "more" may distract from the need to perform and maintain optimal chest compressions while a multitude of (manikin) studies describe **a)** rapid loss of skills, **b)** lack of frequency as well as compression depth recognition, **c)** rapid tiring with loss of depth but not frequency (2), **d)** thresholds for effect on output and **e)** lost time at defibrillation, resulting in the new 1-shock strategy.(3)

Problem description:

For our in-hospital situation, we found that:
- Recognition of compression depth or force by nursing, resident and staff seemed poor without assistance in both a manikin as well as a patient model. (2)
-Time lost at defibrillation was directly proportional to evaluation and charging times. With the 3-4 % decrease in survival min^{-1} in unshocked VF, we had implemented a coordinated, and safe, system allowing continuation of 3-shock blocks.

Focus: This poster emphasizes the need for "good" as well as "more" compressions, the need for feed-back, and describes a way to optimize safe shocks.

Experience:

We have used the CPREzy™ as structural teaching and clinical tool for more than 18 months. With data available from manikin experiments (figures 2-3), with > 75 resuscitations, as well as with modeling we present our experiences with the use of feedback to improve quality during in-hospital Quick Response Team codes. A small case series proved clinical usefulness (figure 4).

Recognition of depth and force (manikins):

Using a convenience sample, in a crossover design, and blinding the candidate, 30 physicians and nurses were sought. Each candidate received a standardized briefing but no practice. A Resusci Anne SIM4000™ (exp1) or Skillmeter (exp2) (Laerdal, Stavanger N) was placed on a hospital bed.(5) An investigator compressed the chest in a predetermined series of depths, either with or without the CPREzy (Health Affairs, London UK). The depth indicator allowed standardization.

The candidate i) determined if compressions were adequate (4-5 cm) or not (too deep or too shallow) and ii) estimated actual depth (mm). After each depth the compressions were interrupted briefly to avoid direct comparison. The crossover was performed one day later.

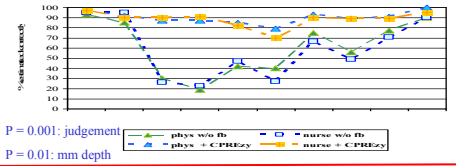
The CPREzy™ *is a small device (240 g, 18 x 5.5cm) which tells you with a flashing light and a beep the frequency at which you should perform thorax compressions (100 min-¹). A 9 Volt battery is needed.. It is placed between the sternum and the hands. It has a moving section, which is pushed down and it will tell you with the five other lights how hard you are pushing. When you push harder, more lights will light up.*

One light: child 40 kg,
Two lights: small adult 55 kg,
Three lights: average adult 75kg,
Four lights: large adult 90 kg,
Five lights: extra large adult.

Figure 1: The CREzy™

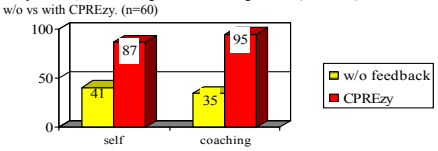
Results: Without feedback, in exp1, only 3 candidates were able to estimate depth ('acceptable' & actual depth). Only 40% recognized 4-5 cm or 20% decrease of AP diameter as goal. This improved slightly to 38% during exp2.

Figure 2: The ability to evaluate depth (as % of correct per depth, exp1)



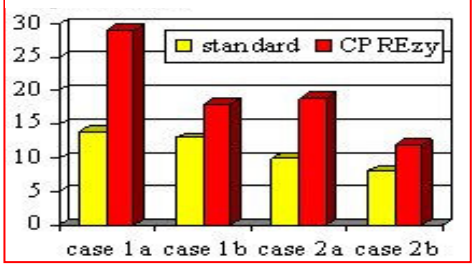
P = 0.001: judgement
P = 0.01: mm depth

Figure 3: Lumped differences (n=60) without versus with the CREzy.
The 'self' columns indicate a candidate evaluating themselve while doing compressions, the 'coaching' while evaluating another (see above). P < 0.001 w/o vs with CPREzy. (n=60)



63% (n=19) always estimated compressions as deeper than being done. Repetition of depth was not recognized (75% overall), and external factors such as *a red face* led to incorrect conclusions. With feedback (CPREzy) the overall 20% improved to 89% within the pilot study. When repeated (exp2, n=30, other candidates) for actual depth similar results were obtained.

Figure 4: Clinical results: $ETCO_2$ w/o and with the CPREzy™



References:
(1)ERC Guidelines for Resuscitation 2005. Resuscitation 2005; 67s1, S3-S6. **(2)**Noordergraaf GJ, et al., The quality of chest compressions by trained personnel: the effect of feedback, via the CPREzy, in a randomized controlled trial using a manikin model. Resuscitation. 2006 (In Press). **(3)**Handley AJ, et al., European Resuscitation Council Guidelines for Resuscitation 2005. Section 2. Adult basic life support and the use of automatic defibrillators. Resuscitation. 2005 6751, s7-s23. **(4)**Steen S, et al., The critical importance of minimal delay between chest compressions and subsequent defibrillation: a hemodynamic explanation. Resuscitation. 2003;58; 249-258. **(5)**Perkins GD, et al., CPREzy: an evaluation during simulated cardiac arrest on a hospital bed. Resuscitation. 2005; 64(1): 103-108. **(6)**C2005 COIs Resuscitation 2005; 67 1.e1-1.e30

Clinical usefulness (case series):

Adding or withdrawing the CPREzy has been demonstrated to have consequences in End-tidal CO_2 outwash, as shown in fig 4. This consecutive series was performed within the first 5-9 minutes of CPR. The $ETCO_2$ never decreased with the CPREzy.

Limiting no-compression time (NCT) during classic 3-shock blocks (mathematical model).

In the new guidelines (1) a 1-shock sequence is advocated. In 2005 we implemented an NCT reduction policy, based on the safety in the CPREzy (complete electrical isolation between caregiver and patient). Clinical observation suggested that time lost was due to rhythm analysis and charging time, each taking between 5-14 seconds.(3,4)

We mandated a) that the defibrillator be (re)charged immediately, b) that compressions continue until the resident is ready to check the EKG, c) the compressions resume immediately after the shock, and d) that the change caregiver for compressions occur during the sequence.

Results (mathematical model of clinical observations): Maintaining a three-shock sequence kept NCT at 50% of the 1-shock system (Table below). This coordinated activity has proved itself safe.

calculation of 9 min VF-protocol total and (per minute)					
	shocks	**compressions**	**NCT**	**max. NCT**	**ventilations**
St. EZ	12 (1,33)	730 (81)	66 (7,33)	6 sec	45 (5)
E.R.C.	5 (0,55)	665 (73,88)	150 (16,66)	30 sec	60 (6,66)

Discussion:

The C2005 COIs (6) suggest that prompts improve the quality of compressions and adherence to standards. New AED'sare also incorporating accelerators pressure sensors to aid layman in applying sufficient pressure to generate output. All studies are in line with these careful suggestions but our data suggests we go further. (2,5)

We suggest that the individualization of care and improved quality –with some extra work- with the CPREzy may improve outcome.

The electrically isolating properties in the CPREzy also increase the safety of the caregiver doing compressions. Our system allows the goals suggested in the 2005 guidelines without loss of shocks in the first crucial nine minutes and may offer clinical data.

Conclusions:

- Feedback is an essential, but as yet underemphasized, tool in CPR.
- The CPREzy™ is a suitable, reliable and robust device suitable for laymen and professionals.
- Chest compressions after each shock reduce the no compression time (NCT) from 30 to a few seconds, allowing a 3-shock strategy.

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