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Original Research

## LUCAS™2 in Danish Search and Rescue Helicopters

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## A B S T R A C T

**Objective:** Prehospital resuscitation is often challenging. Giving uninterrupted and effective compressions is relatively impossible during transportation. In 2012, The Royal Danish Air Force received a donation of 8 mechanical chest compression devices (LUCAS™2; Physio-Control/Jolife AB, Lund, Sweden) to be used onboard the Danish search and rescue (SAR) helicopters. The scope of this investigation was to establish whether or not mechanical chest compression devices should be considered a necessity onboard the Danish SAR helicopters.

**Methods:** Data were compiled from SAR medical journals. From the data collected, observations were made as to when LUCAS™2 was used and what diagnosis the SAR physician made.

**Results:** One thousand ninety missions were registered in the 24-month research period, and LUCAS™2 was used in 25 missions. Cardiac emergencies amounted for 25% of the missions.

**Conclusion:** The Danish SAR helicopters retrieved 33 drowned/hypothermic patients during the research period, and the LUCAS™2 was used in 11 of the patients requiring resuscitation. The LUCAS™2 was frequently used during other emergencies like sudden cardiac arrest. Cardiac emergencies were the predominant type of mission. LUCAS™2 is now considered mandatory on Danish SAR helicopters

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The Royal Danish Air Force search and rescue (SAR) helicopters undertake about 500 to 750 missions each year. The majority of these missions are civilian medical emergencies like cardiac problems, drowning, stroke, and so on.

Prehospital resuscitation is often challenging. During manual chest compressions, problems can occur. For example, the resuscitator can experience fatigue, and effective compressions are relatively impossible during transportation by stretcher. These challenges can be remedied by using mechanical chest compression devices like the Lund University Cardiopulmonary Assist System (LUCAS™2). LUCAS™2 is an electrically driven device that delivers chest compressions in the center of the chest. It incorporates a replaceable lithium battery with a run time of a minimum of 45 minutes and can run continuously when connected to 230 V (Fig. 1).

Another benefit of LUCAS™2 is the possibility of performing direct current conversion without interrupting chest compressions, avoiding the resulting decrease in coronary perfusion. In comparison with manual chest compressions, LUCAS™ provides improved

circulation and fewer discontinuities.<sup>1</sup> This benefit has also been shown during simulations of helicopter transportation in which LUCAS™ provided more correct chest compressions compared with manual chest compressions.<sup>2,3</sup> Similar results have been found in ambulance research.<sup>4</sup>

Additionally, Danish cases have shown successful resuscitations by the sustained use of LUCAS™ onboard the Danish SAR helicopters.<sup>5,6</sup> A minor study showed no additional injuries inflicted on the patient when using LUCAS™ compared with manual chest compressions.<sup>7</sup> However, a larger study (N = 222) revealed an increased number of rib fractures during mechanical chest compressions.<sup>8</sup> Furthermore, the chest compressions can continue during percutaneous coronary intervention.<sup>9,10</sup>

The LUCAS™2 devices currently used by the Royal Danish Air Force were purchased using donations from “TRYGFonden” in 2012. The scope of this investigation is to establish whether or not mechanical chest compression devices should be considered a necessity onboard the Danish SAR helicopters.

### The Danish SAR Helicopters

The Royal Danish Air Force maintains 24-hour preparedness for 3 large SAR helicopters (AgustaWestland EH-101 Merlin). The total fleet of helicopters equipped in SAR configuration consists of 8 units.

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**Figure 1.** The LUCAS™2 in the patient terminal inside the Danish search and rescue helicopter.

All 3 on-duty helicopters are on a 15-minute standby during daytime and 30-minute standby at night, and the actual takeoff times are approximately 9 minutes and 12 minutes, respectively. The helicopters are located in Aalborg, Skrydstrup, and Roskilde. Originally, the SAR helicopters were intended solely for military use, and even though Denmark has a civilian helicopter emergency medical service, the current predominant use of the SAR helicopters is for civilian purposes.

The Joint Rescue Coordination Center, associated with Defense Command Denmark, activates and coordinates all upcoming missions. Communication to the Joint Rescue Coordination Center will often originate from the Emergency Medical Center of Coordination or the Danish National Police in an emergency situation.

The crew on the SAR helicopter consists of 6 persons, including an SAR physician and a medic. Types of civilian missions include SAR, interhospital transportations, evacuations of patients (ie, from a ship or an island), and ambulance flights (first unit at scene after the primary ambulance).

## Methods

We reviewed all records from missions performed by the SAR helicopters during a 2-year period from March 1, 2012, to February 28, 2014. All records were registered, with special attention to patients treated with the LUCAS™2 device and patients with a risk of cardiac arrest, defined as all patients transported because of a cardiac disease. The diagnosis was defined as the tentative diagnosis of the SAR physician. It was not possible to follow up after admission to the hospital because of Danish legislation.

Patients were monitored with LIFEPAK 12 Defibrillator/Monitor (Physio-Control, Redmond, WA, USA), allowing the physician to assess vital values like SpO<sub>2</sub>, end-tidal carbon dioxide, blood pressure, and cardiac rhythm in flight. The European

Resuscitation Council guidelines for resuscitation 2010 were used during cardiac arrest.

We were able to bring the LUCAS™2 on every flight because of its small size (65 × 32 × 28 cm) when packed in its carrying bag. The total weight was 10.8 kg including 1 spare battery and suction cup, a charger with cords, and a neck strap.

This retrospective follow-up study was approved by the Danish National Committee on Health Research Ethics (paragraph 14, section 2) and general approval (2008-58-0028) from the Danish Data Protection Agency given to the North Denmark Region.

## Results

During the research period, 1,090 missions were registered by the SAR physicians. The number of missions was almost evenly divided between the 3 SAR stations, with most missions occurring in the summertime, as shown in [Figure 2](#).

### Categorization

We have categorized all the suspected causes for transporting patients with the Danish SAR helicopter ([Figure 3](#) and [Table 1](#)).

### Using the LUCAS™2

LUCAS™2 was used on 25 patients in total, and its usage was equally distributed over the research period ([Table 2](#)). The patients were mainly collected from islands and beaches and were, in almost every case, transported to the nearest university hospital while receiving ongoing resuscitation. In 2 of the cases, the treatment ended during transportation. The mortality rate has not been investigated.

## Discussion

The 1,090 registered missions during the research period are based on medical records, whereas the number of registered

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