The Search and Rescue Service in Denmark has in recent years changed the nature of its work from less search to more rescue, and at the same time from mainly military tasks to 85 percent civilian tasks. Here, especially, more frequent transportation of patients from isolated areas in Denmark and from smaller hospitals to larger ones with specialized departments, including coronary care units has been undertaken.

This means that more and more patients have to be observed very closely during transport, especially their vital functions like heart action and circulation.

These observations can in most cases not be performed as is usual, since in the helicopter it is extremely noisy and there is frequent electrical disturbance from the helicopter instruments and equipment.

This makes evaluation of the circulatory condition for example rather difficult, and the observations have to be largely performed by means of a mobile EKG-oscilloscope (with defibrillator) for example. It was found necessary to develop a dependable and safe method for continuous observation of the patient's heart function via an EKG on an oscilloscope, and it was found expedient to register the EKG on a cassette recorder for evaluation and guidance concerning later treatment. Finally if possible a system is to be developed for transmitting the EKG signal from a patient by means of AM/FM telemetry during transport to the hospital or coronary center, and thereby if necessary to obtain advice and guidance from medical specialists on the ground during transportation. This is of course of special value if no physician has joined the crew to accompany the patient.

This preliminary work was done on healthy persons, namely the helicopter pilots during routine flights.

The electronic equipment was designed in collaboration with Philips Medical Systems, Copenhagen.

Initially the recording of an EKG in a helicopter turned out to be rather difficult, as much noise from the helicopter's electronic equipment disturbed the EKG signal to such an extent that it was impossible to identify the complexes on the oscilloscope and for the heart rate meter to count the R-waves.

The monitoring equipment consists of a signal pickup in the form of three disposable EKG electrodes (so called astronaut electrodes), which are attached to the chest of the monitored person with adhesive tape, specially chosen so that it does not lose contact even with profuse sweating. The skin was prepared by degreasing and slight abrasion in order to get a low impedance. Before the electrodes were connected to light weight flexible cables, conductive electrode gel was injected by a syringe into each electrode. The position of the electrodes was chosen to give tall R-waves and small or negative T-waves. This is obtained by a lead practically identical to the preccordial V2.

R. Frey et al. (eds.), Mobile Intensive Care Units
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During flight the electrodes were connected to a modulator by means of cables, which were as short as possible and specially insulated. In the modulator the obtained electrical EKG-signal is amplified and then converted to a "sound" signal for recording on a commercial battery-operated single channel cassette recorder.

Careful preparation was necessary to obtain satisfactory results, but on the other hand only brief instruction and very little experience was necessary to obtain a good recording, and the performance of the procedures lasted only a few minutes.

During flight the heart beats were also checked acoustically by means of an earphone clip connected to the recorder's "sound" outlet. Furthermore, a signal could be added to the recording by means of a 1 mV calibration pulse knob in order to mark special events or changes in the condition.

The obtained signal was, as mentioned, recorded on a small compact cassette recorder, and the signal was of such a character and power, that there are no practical technical limitations to transmitting the signal via a radio transmitter either on "Citizen" band, UHF or VHF. Optimally a special "EKG channel" should be used for this purpose, thus opening up the possibility of transmitting by radio telemetry uninterruptedly the EKG signal from patients transported in helicopters or ambulances to coronary centers in hospitals for evaluation and if necessary, for advice from specialists there. The helicopter has in this respect an advantage, as the signal is usually not reduced or disturbed by geographical conditions such as hills or valleys.

Technical specialists agree that it is not a big problem to send the amplified and converted signal from the heart muscle via VHF or UHF to a receiver in a hospital, as the signals recorded on the tape in the helicopter are to a very great extent free from disturbing noise. However, there may be some administrative problems, as the radio bands are extremely crowded, and it should be secured by international agreements that if possible the same emergency "EKG channel" is used everywhere, and that such transmissions are not disturbed by other kinds of transmissions.

After flight, the cassette, which has a total recording time of up to 2 hours, is played back on a similar tape recorder and the demodulated signal (1 V/1 mV) connected to a heart rate meter indicating the heart rate on a meter scale, range: 0 to 200 beats per minute.

The recorded EKG is shown and evaluated on a single channel oscilloscope for a more detailed study of series of complexes. Specials parts of the recordings are investigated by an R-R interval unit to find appearance of any arrhythmias during the flight.

It can be concluded that the described system opens up possibilities to make exact EKG recordings continuously during flight for later study, guidance, and interpretation.

If a physician has not joined the crew, it is presumably justifiable to let a well-trained first aider perform defibrillation if necessary, and it is of course in such cases very important and reassuring, if these persons could be in close contact with cardiologists or other physicians in the hospital coronary unit, for example via radio and telemetry.