Use of Automated External Defibrillators in a Brazilian Airline. A 1-Year Experience

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After the incorporation of automated external defibrilators by other airlines and the support of the Brazilian Society of cardiology, Varig Airlines Began the onboard defibrilation program with the initial purpose of equiping wide-body aircrafts frequently used in international flights and that airplanes use in the Rio - São Paulo route. With all fight attendants trained, the automated. External defibrilation devides were incorporated to 34 airplanes of a total pleet of 80 aircrats. The devices were intalled in the bagage compartments secured with velero straps and 2 pairs of electrods, one or which pre-conected to the device to minimize application time. Later, a portable monitor was addres to the ressocitation kit in the long flights. The expansion of the knowledge of the basic life support fundamentors and the correted implantation of the survival chain and of the automated external defibrilators will increase the extense of recovery of cardiorespiratory arrest victins in aircrafts.

The use of automated external defibrillators represents a significant step in the effort of airlines to better handle medical emergencies occurring onboard commercial aircraft flights.

Onboard defibrilation programs are in perfect accordance with the guidelines established by the International Liaison Committee on Resuscitation (ILCOR) of the American Heart Association and by the Comitê Nacional de Resuscitação do Funcor of the Brazilian Society of Cardiology in Brazil [1,2].

Review of data from Varig (a Brazilian airline), even though the data are incosnsistent, alowed estimation of the occurrence of onboard deaths in every 1.6 million passengers; most of these passengers didi not identify themselves as being ill when boarding the aircraft.

Sudden death is certainly a feared event in the course of coronary heart disease, and, even though rare, this is the most common type of death occurring aboard commercial aircraft [3-5].

The aim of this study is to report the establishment of a program for onboard defibrilation in a major Brazilian airline, and to review the cases in the first year of the pregnancy.

Methods

In February '97, after the announcement by other airlines of the use of automated external defibrillators and with the encouragement of the Brazilian Society of Cardiology, the medical management of Varig launched its onboard defibrillation project. Initially, the objective was to equip wide-body aircraft (5 Boeing 747s, 10 MD-11s, 8 DC-10s, and 8 Boeing 767s), which were most frequently used for international flights, and 3 aircraft used in the Rio-São Paulo route (Boeing 737-300), with defibrillators.

Because the presence of a physician onboard an aircraft is casual and a request for medical cooperation from such a person is not always welcome [6,7] and because most physicians are not acquainted with automated external defibrillators, Varig chose the flight attendant as the focus of the training program conducted according to the guidelines of the American Heart Association for public access defibrillation [2].

Aiming to launch the project when enough flight attendants had been trained to guarantee the presence of at least one trained attendant per flight, we chose to start the training program with chief purser. Therefore, the flight schedule itself would solve the problem of assigning trained staff, because one chief purser is required per flight. In addition, chief purser are directly responsible for the safety of the passengers, which makes them a natural choice for assuming this responsibility.

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Aiming to receive world recognition for having a high-caliber training program and also to adhere to the recommendations of the international committees on resuscitation in regard to the program, we decided to use the American Heart Association Heartsaver-Plus course, with special emphasis on automated external defibrillation. Therefore, in January '98, 20 members of the medical service of the Brazilian airline received certification as instructors in Basic Life Support (BLS), which allowed rapid training of chief purser. This training included initial supervision by the Brazilian Society of Cardiology and also from instructors provided by the manufacturer of the automated external defibrillator.

Once it had been decided that the person in charge of defibrillation equipment would be the flight attendant, we chose a model of automated external defibrillator that had no cardiac monitor. We added instead a separate device for electrocardiographic monitoring to complete the set of equipment. This was because of the possibility of the following 2 situations happening in flight: the presence of a trained/untrained physician or the absence of a physician, combined with these 2 scenarios, either the presence or absence of cardiac arrest. Figure 1 summarizes the needs in these cases. A ventilation mask was also added to the onboard first aid kit.

By the end of April '98, when all lead flight attendants had been trained, 34 out of a fleet of 80 aircraft were equipped with automated external defibrillators (Lifepak 500 – Physio-Control).

The equipment was installed inside the overhead baggage compartment and was held in place by Velcro straps. Each automated external defibrillator was accompanied by a pair of electrodes, one of them preconnected to minimize the time of application. In January '99, a portable monitor (Biolog 3000 - Micromedical) was added to the set of resuscitation equipment used in long-haul flights (flight duration ≥8 hours) only.

Case reports

Case 1 – In July '98, a 50-year-old male passenger with no previous history of heart disease reported malaise, precordial pain, and asked the flight attendant for help during a flight to Portugal, after the breakfast service (30 minutes from the airport of destination). The passenger stood up and fainted over a row of empty seats.

Other passengers, a physician, and the chief purser observed the fall. According to reports, the automated external defibrillator was applied in 2 minutes. Four passengers, who were physicians, promptly volunteered to assist the passenger.

The initial cardiac rhythm recorded by the automated external defibrillator was ventricular fibrillation. The device correctly recommended a shock that was administered in 20 seconds. A period of asystole followed and then a new ventricular fibrillation occurred. Two new shocks were applied, according to the standard sequence of energy increase, resulting in temporary reversion of the arrhythmia, which was followed by ventricular fibrillation once again. Review of the recordings of the automated external defibrillator showed that after the fourth shock, a sustained reversion with a pattern of bundle-branch block and probable atrial fibrillation occurred. As the monitor had not yet been installed onboard, the electrical reversion of the ventricular fibrillation could not be diagnosed. Because of this and as the spontaneous return of circulation or breathing was not detected, the resuscitation maneuvers were interrupted and death occurred in flight (fig. 2).

Case 2 – In August '98, a 34-year-old female passenger experienced syncope when heading to the lavatory during a flight to the United States. When required, 4 physicians offered to help. The passenger was conscious but could not clearly describe what had happened. In a second attempt to go to the lavatory, a new syncopal episode occurred with loss of consciousness.

Even though the passenger's pulse was perceptible and her breathing spontaneous, the physicians chose to apply the automated external defibrillator aiming at monito-

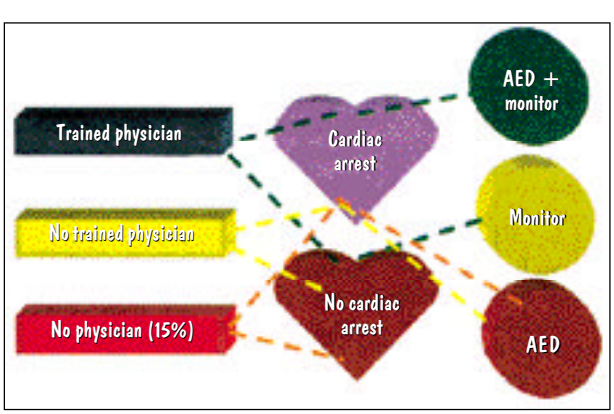

Fig. 1 – Rationale basis to implement AED on board.

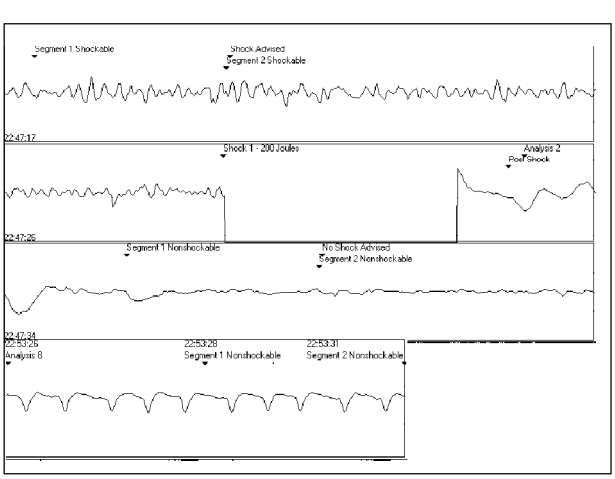

Fig. 2 – Case 1 - 1st inicial ventricular fibrillation (VF); 2nd - 200 Joules; 3rd - assistoly period post-chock; 4th VF revertion after 360 Joules with QRS enlarged with left brunch block pattern.

ring, which was not possible with the only type of device then available aboard.

The automated external defibrillator correctly did not recommend shock. Review of the recording showed a pattern of probable right bundle-branch block and a possible atrial flutter with a high-degree atrioventricular block. The patient had periods of bradichardia and asystole, requiring cardiorespiratory resuscitation maneuvers. Thanks to the volunteer physicians, the patient disembarked alive after more than 30 minutes of resuscitation maneuvers, but she died 2 days later in an intensive care unit. The initial rhythm and the bradichardia period are depicted in figure 3.

Case 3 – In October '98, during a an survival procedure in São Paulo, a 55-year-old female passenger probably with heart disease had syncope, while standing waiting to leave the aircraft, that was witnessed by a flight attendant, who had been trained in the BLS-automated external defibrillator. The lead flight attendant was called, and he brought an automated external defibrillator at the same time a physician spontaneously offered to help. Figure 4 shows the initial rhythm recorded, which was interpreted as an atrioventricular dissociation and occasional paired ventricular ectopic beats (not shown). When the airport medical team arrived, within a few minutes, a cardiorespiratory arrest was detected, and cardiorespiratory resuscitation maneuvers were started. After 1 minute of cardiorespiratory resuscitation, ventricular fibrillation appeared. The automated external defibrillator operated by the chief purser correctly recommended shock, which resulted in reversion to sinus rhythm with a single monophasic discharge of 200 J. The patient regained her carotid pulse and spontaneous breathing. The procedures for transferring the patient to a medical center were started, and the airport medical team took charge of the patient. The automated external defibrillator was unfortunately disconnected. During transfer to the hospital, the patient had a new cardiorespiratory arrest and died in the hospital, where, according to reports, new shocks were applied.

Discussion

The advent automated external defibrillators is an important landmark in the fight against out-of-hospital sudden death [8,9]. Use of automated external defibrillators by many airlines around the world has been a hotly debated issue in the international medical community. If, on the one

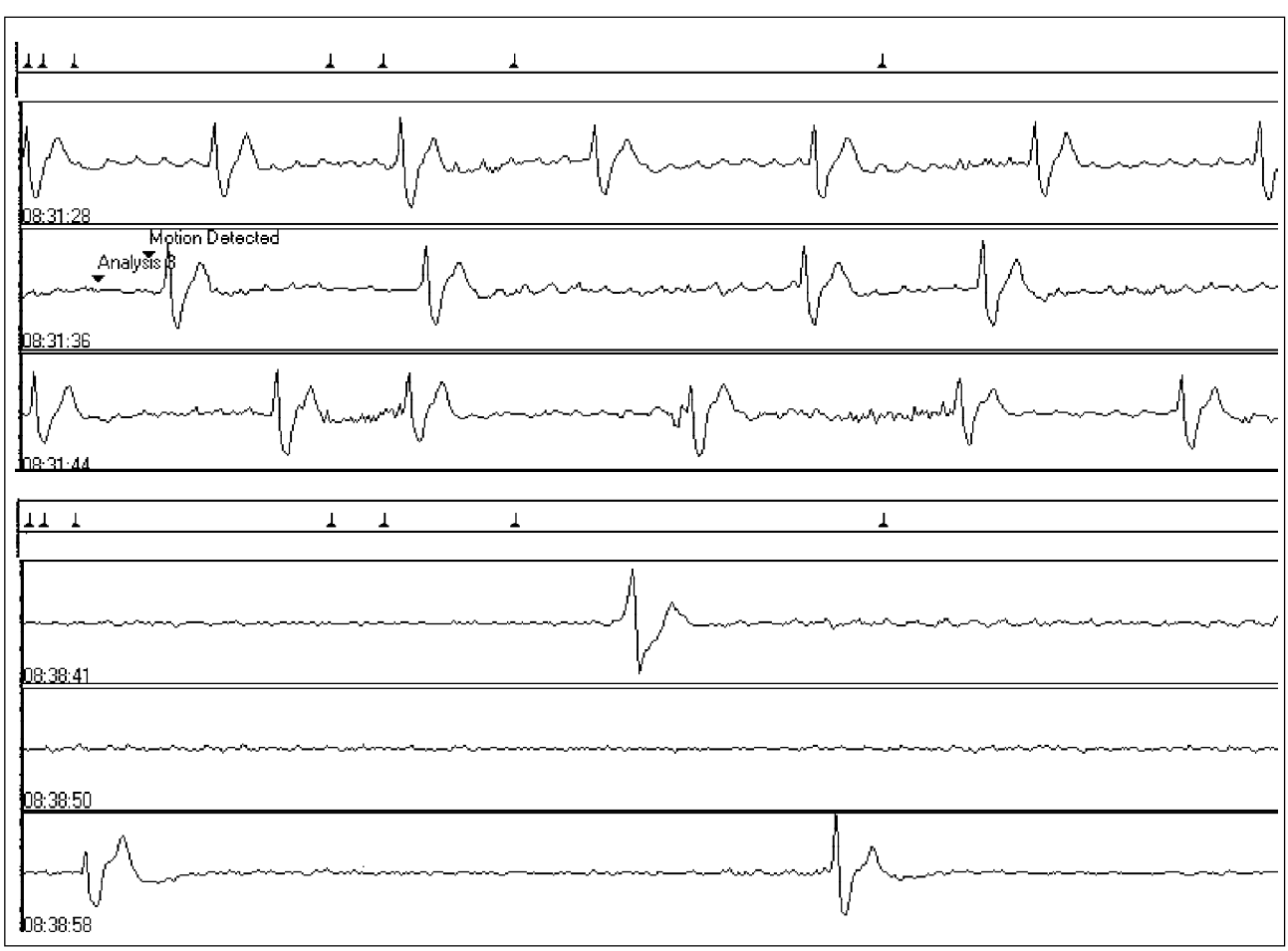

Fig. 3 – Case 2 - Initial rhythm: flutter or atrial tachycardia with AV block high degree and right brunch block pattern. In the 2nd strip period of bradi/assistoly.

Fig. 4 – Case 3 - Initial strip connect to the electorde; intermediate strips VF with chock; inferior strips 2 minutes after VF successfully revert, wth sinus rhythm and STT normal.

hand, the programs received wide support from medical societies involved with resuscitation, on the other, they are criticized because of their unfavorable cost/benefit ratio, which was estimated by preliminary projections of the small number of lives that would potentially be saved. The topic has also been greatly debated in the lay press [10], with articles that have certainly contributed to motivate the airlines to take action. The most recent consequence was the position of the Aerospace Medical Association (AsMA) recommending the use of automated external defibrillators in specific routes, mainly the transoceanic routes, in long-haul aircraft [11].

Usually, the actual calculation of the cost/benefit ratio in cases involving safety depends mainly on the cost deriving from the accident avoided. This type of reasoning, so common in the aviation industry, justifies the use of fire extinguishers that fortunately may never be used despite all their necessary maintenance logistics.

Everyone involved with the principles of BLS (basic life support) and ACLS (advanced cardiac life support) is totally convinced, medically and philosophically, that incorporation of onboard automated external defibrillators is the most legitimate translation of the concept of public access defibrillation by airlines.

In 1986, Peter Chapman and Douglas Chamberlain (personal communication), who worked at that time for British Caledonian, were the first to introduce the Physio-Control automated external defibrillators in onboard medical kits.

In 1990, another British company, Virgin Atlantic, introduced automated external defibrillators (Lifepak 100 Physio-Control), which were recently changed to more modern versions by the same manufacturer. In December '97, in a flight from London to Miami, a 70-year-old passenger was successfully defibrillated after the administration of 4 shocks in a period of 6 minutes. The flight attendants operated the Lifepak 500 and provided basic life support with the aid of a volunteer physician onboard. This patient was discharged from the hospital and survived for more than one year after the implantation of an automated defibrillator.

The Australian airline Qantas has the largest experience with onboard automated external defibrillators [12]. In 1991, they introduced into their already extensive medical kit the Dutch Laerdal automated external defibrillator, the Heartstart 3000.

With a well-structured program, Qantas has accumulated a total of 46 episodes of use of automated external defibrillators, 27 of which were in-flight. In 23 out of these 46 cases, the cardiac rhythm was ventricular fibrillation. In the 27 cases that occurred in-flight, 2 passengers were long-term

survivors, representing a 7.4% survival rate. This rate is certainly much higher than that obtained in some large cities in some the United States in regard to out-of-hospital cardiorespiratory arrest [13].

In July '97, American Airlines started its program of onboard defibrillation, equipping all its fleet of intercontinental aircraft with Heartstream defibrillators, working hard to raise the consciousness of the aeromedical community [14]. Six months after starting the program, the first rescue was reported[15]. The passenger was a 53-year-old male, who suffered a cardiorespiratory arrest when the aircraft was still on the ground right after the doors were closed. The passenger was resuscitated with a single biphasic shock of 130 J and regained consciousness without being intubated. More recently, another American Airlines passenger was defibrillated during a flight [16], being the first case reported on a domestic flight.

We have learned a lot from critical review of our first-year experience. In all our cases, we were able to reach some significant objectives. Onboard defibrillation has proved feasible, thanks to the training provided for flight attendants in regard to the use of automated external defibrillators. All 5 episodes of ventricular fibrillation were properly treated onboard with establishment of a final rhythm potentially perfusional in 1 case and perfusional in another. This means that, despite the difficulties inherent in the environment of the aircraft cabin, the 3 initial links of the "Chain of Survival" were satisfactorily accomplished [17,18.]

The fate of the passengers who died might have been different if a cardiac monitor was already being used in case 1 and if the patient in case 2 could have been better stabilized, or if better resources were available.

Physicians and other health professionals need to become better acquainted with automated external defibrillators. These are devices that will be present more and more in public environments, such as airports, shopping malls, sports plazas, etc, [19,20]because of the increasing risks of cardiorespiratory arrest, and volunteer health professionals are a natural resource in these situations. Therefore, we believe that by spreading knowledge about Basic Life Support with the correct implementation of the "Chain of Survival", we will increase the chance of saving these victims of out-of-hospital cardiorespiratory arrest.

No doubt better knowledge about the operation of automated external defibrillators by volunteers might also have brought about a different result in our case series. Most automated external defibrillators commercially available can recognize ventricular fibrillation and also persistent asystole. These characteristics should not be used as a criterion for interrupting the maneuvers of cardiorespiratory resuscitation; however, they may indicate when these efforts should not be interrupted when asystole is not present.

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