

# Air transfer of patients with intra-aortic balloon pump support

## Swiss experience and recommendations

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### Summary

**BACKGROUND AND AIM:** Inter-hospital transfers are high-risk operations for critically ill patients dependent on intra-aortic balloon pump (IABP) support. Since September 2008, Swiss Air-Rescue (Rega) has offered such transfers by helicopter. The aim of the present study was to review the first 38 IABP transfers and to promulgate the currently used standard operating procedure (SOP).

**METHODS:** All helicopter transfers of IABP-dependent patients by Swiss Air-Rescue (Rega) between September 2008 and October 2010 were retrospectively analysed. Adverse events (e.g., death), vital parameters and respiratory modus during takeover by the Rega crew and discharge at the receiving hospital, as well as patient demographics, aetiology of heart failure and outcome at the receiving hospital were assessed.

**RESULTS:** A total of 38 IABP transfers occurred, 35 of which were carried out to hospitals within Switzerland. No major adverse events were observed during flight. The mean patient age was  $64 \pm 11$  (mean  $\pm$  SD) years. The leading cause for IABP support was ischaemic heart failure (32 patients, 84%). The outcome of 35 patients was available: 30 were discharged home or to another institution, and 5 died at the receiving hospital.

**CONCLUSIONS:** Based on these findings, the helicopter transport, the equipment provided, the crew composition and the predefined process offer a safe concept for these complex transfers. The adherence to standard operating procedures is a precondition to achieve excellent quality of care, facilitating and accelerating the hand-over and comprehensive care of such high-risk patients.

**Key words:** inter-hospital transfer; transport; intra-aortic balloon pump; cardiac failure

### Introduction

Intra-aortic balloon pump (IABP) counter-pulsation support is a recommended option for patients with cardiac failure, mainly due to coronary artery disease or congestive

heart failure [1, 2]. Early IABP support is used to accompany acute percutaneous coronary intervention (PCI) or cardiac surgery. In addition, IABP support may function as a bridge prior to invasive procedures if these specialities are not immediately available or are unavailable at the initial hospital of admission. If in such a situation inter-hospital transfer is mandatory, IABP support must be maintained. Inter-hospital transfers of patients with IABP support have been successfully carried out by ground and by air transport [3, 4]. Since July 2008, the Swiss Air-Rescue (Rega, Zurich-Airport) has been willing to provide IABP transports by helicopter or jet, 24 hours a day, 365 days a year. The IABP can be supplemented with an air transport approved extracorporeal membrane oxygenation device and/or with a left ventricular assist device (e.g., Novalung<sup>®</sup>, Impella<sup>®</sup>, Life-Box<sup>®</sup> and Cardiohelp<sup>®</sup>). Inter-hospital transfers are high-risk operations for seriously ill patients. The aim of the present study was to review the first two years of transport of patients with IABP by Rega and based on this experience, develop and promulgate a standard operating procedure (SOP) for the hospitals involved with the intention to minimise transportation hazards and streamline the handover processes at the sending

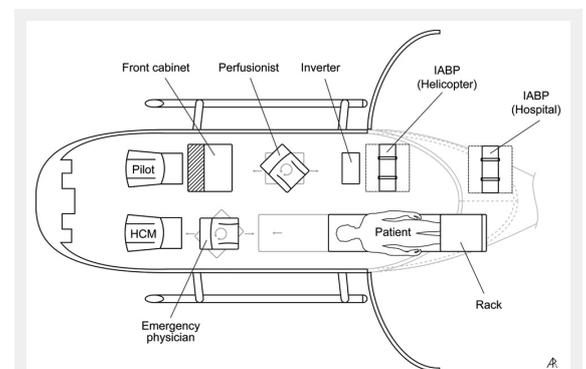


Figure 1

Positioning of patient, crew members and specific devices within the helicopter (back doors open). HCM: Helicopter Emergency Medical Services Crew Member; IABP: Intra-aortic balloon pump.

and receiving institutions, thereby increasing patient safety. In addition, we would like to provide insight into the situation experienced by emergency physicians responsible for the transfer.

## Methods

All helicopter transfers of patients with IABP support by Swiss Air-Rescue (Rega, Zurich-Airport, Switzerland) between September 2008 and October 2010 were retrospectively analysed. Approval for this study was received from the responsible ethics committee (Ethikkommission beider Basel). No exclusion criteria were applied. The major endpoints included death, cardiopulmonary resuscitation, accidental loss of airway, major bleeding at the IABP puncture site or dislocation/disconnection of the device during transport. The minor endpoints were addressed as non-life-threatening cardiovascular, respiratory or neurological problems, or nausea/vomiting. In addition, data were analysed with regard to the geographical distribution of the transfers, patient demographics, aetiology of cardiac failure, haemodynamic and respiratory data. Data were extracted from the Rega patient chart and Rega database. For outcome data, a questionnaire was sent by mail to the receiving hospital to determine: death at the receiving hospital,

or discharge with destination (home/institution and type of institution).

All patients for IABP transfer were transported by a Eurocopter EC145 helicopter, staffed with the standard Rega helicopter crew (pilot, helicopter emergency medical services crew member (HCM) and emergency physician) and reinforced by a certified perfusionist. The emergency physicians involved were board-certified anaesthesiologists or anaesthesiologists at certification level with training in cardiac anaesthesia, plus board-certified pre-hospital emergency physicians (Fähigkeitsausweis Notarzt SGNOR) or pre-hospital emergency physicians at certification level. Positioning of the patient, crew members and specific devices within the helicopter is shown in figure 1.

The process of IABP transfer is organised as follows: Upon receiving the request for transfer, the Rega IABP (Datascope GmbH, Bensheim, Germany; CS300) is immediately installed in the helicopter at the base of dispatch prior to the mission. At the hospital of pickup, the IABP-supported patient has to be transferred from the hospital unit to the helipad while still connected to the hospital's IABP device (fig. 2). After loading the patient into the helicopter, the balloon catheter connections (Datascope, Bensheim, Germany IAB 7Fr Balloon-Catheter) are switched from the hospital's pump unit to the helicopter's IABP unit. At the target hospital, the process is reversed and the balloon catheter connections are switched back from the stationary IABP in the helicopter to the pump unit of the target hospital. It is important that all referring and receiving hospitals are aware of this process. Specifically, all health care providers directly involved must be fully informed about the timing, the site of handover and the respective steps of the required protocol.

During the entire transfer from the patient's initial location in the referring hospital until the handover at the target location in the receiving hospital, the regular helicopter monitoring, infusion pumps and ventilator were employed. A Propaq Encore monitor (Protocol Systems, Inc, Beaverton, OR, USA), providing standard monitoring (ECG, non-invasive blood pressure and SpO<sub>2</sub>) including invasive arterial pressure and end-tidal CO<sub>2</sub>-measurement, was used for haemodynamic and respiratory surveillance of the patient during transport. If necessary, ventilation was provided using an Oxylog 3000 (Draeger Medical, Lübeck, Germany; SRMS 0020), and infusion pumps (Braun, Melsungen, Germany) were connected (fig. 3).

Data were recorded in Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Statistics were calculated using IBM SPSS Statistics 19.0 (IBM Corp., Armonk, NY, USA). Data are presented as descriptive statistics. Values are shown as means  $\pm$  SD and range.

## Results

Between September 2008 and October 2010, 38 patients (28 male, 10 female) with an IABP were transported by Rega helicopter. The geographic distribution of patient transfers within Switzerland is shown in figure 4. One patient transfer was from France to a Swiss hospital. Three patient transfers were conducted outside Switzerland (France [1 patient], Germany [2 patients]).



**Figure 2**  
IABP switch occurring on the helipad.



**Figure 3**  
Rear cabin of the EC145 showing dimensions and available space when occupied by a patient and Rega team, including a perfusionist.



ation, and emergency physicians involved in the transfer were only made aware of a limited amount of medical information regarding the patient.

Clinical evidence supporting IABP use for cardiogenic shock remains controversial. The SMASH (Swiss Multi-centre Evaluation of Early Angioplasty for Shock Following Myocardial Infarction) and TACTICS (Thrombolysis and Counterpulsation to Improve Survival in Myocardial Infarction Complicated by Hypotension and Suspected Cardiogenic Shock) trials had to be stopped before reaching sufficient patient inclusion for the calculated population sizes [11, 12]. Two further early investigations on IABP support were also disappointing [13, 14]. Recent studies [15, 16] as well as current guidelines [17] remain ambiguous with regard to clear recommendations for mechanical circulatory support in cardiogenic shock. Obviously, data on IABP support in cardiac failure are confounded by a systematic negative selection of the patients analysed.

Our data indicate that IABP used as a bridge prior to invasive acute intervention for cardiac failure can be used safely during helicopter transfer between primary care and specialised hospitals. Middle-range outcome data for our patient collective is promising, and IABP use despite all of the above-mentioned limitations has also been supported by a benchmark registry [18] and a recent IABP-shock trial [15]. A current editorial by Ohlmann et al. recommend the routine use of IABP in acute myocardial infarction patients with pre-shock or cardiogenic shock [19].

Costs for helicopter transfer provided by Swiss Air-Rescue (Rega) are calculated based on flight minutes. Our data show that the flight times for IABP patients are average compared with other inter-hospital transfers ( $22 \pm 10$  min). In contrast, the time from landing at the referring hospital to taking off with the IABP patient is substantially longer ( $68 \pm 30$  min; range: 39–168 min), demonstrating the complexity of patient handling. In addition, installation and removal of the pump in the helicopter require at least 30 additional minutes for each step. In most patients, the time required for safe implementation of IABP transfer exceeds the 90-minute door-to-balloon time recommended for emergency PCI. Therefore, in patients transferred for this procedure, insertion of a mechanical support device with consecutive delay must be balanced against loss of time.

For that reason, a comprehensive understanding of the underlying process and agreement regarding the priorities of patient management is mandatory to facilitate and accelerate handover and overall care of these critically ill patients. Implementation of a specialised team for this purpose has been recommended recently [7]. In addition, a well-defined process increases patient and crew safety. This is why we developed a standard operating procedure (SOP) for the IABP transfers. We communicate the attached SOP (Appendix A) and respective checklist for the referring and receiving hospitals (Appendix B). Rega provides this checklist in English, German, French and Italian for convenience.

## Limitations

This report is purely an observational investigation. Lack of a control group prevents the authors from making any conclusion on the effectiveness of mechanical circulatory support or risk/benefit ratio. One purpose of the manuscript is to provide the readers with some insight into the situation as experienced by emergency physicians responsible for the transfer. Individual cases are discussed in depth between the responsible staff physicians from the transfer-requesting hospital and the patient-receiving colleague at the target hospital. At the point at which the emergency physician becomes a part of the team, everything concerning the patient's current and future treatment has been decided. As a consequence, the information provided to the helicopter physician is limited, with a focus restricted to what is medically necessary for the transfer. Due to our limited participation in the process as a whole, no specific haemodynamic or echocardiographic parameters or data were collected. In addition, the number of patients included is small. Rare complications will, therefore, remain undetected. Nevertheless, the case series is a consecutive summary of all respective transfers carried out by Rega during this 26-month period.

## Conclusion

Inter-hospital transfers are high-risk operations for seriously ill patients. Following a predefined protocol and with well-informed referring and receiving hospitals and a specifically trained team, IABP-dependent patients with cardiac failure can be safely transported by helicopter to highly specialised centres for further invasive interventional or surgical care.

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## Attachments

- [Appendix A: Standard operating procedure \(SOP\) for inter-hospital transfers of IABP-dependent patients \(pdf\).](#)  
[Appendix B: Checklist for referring hospitals \(pdf\).](#)

Figures (large format)

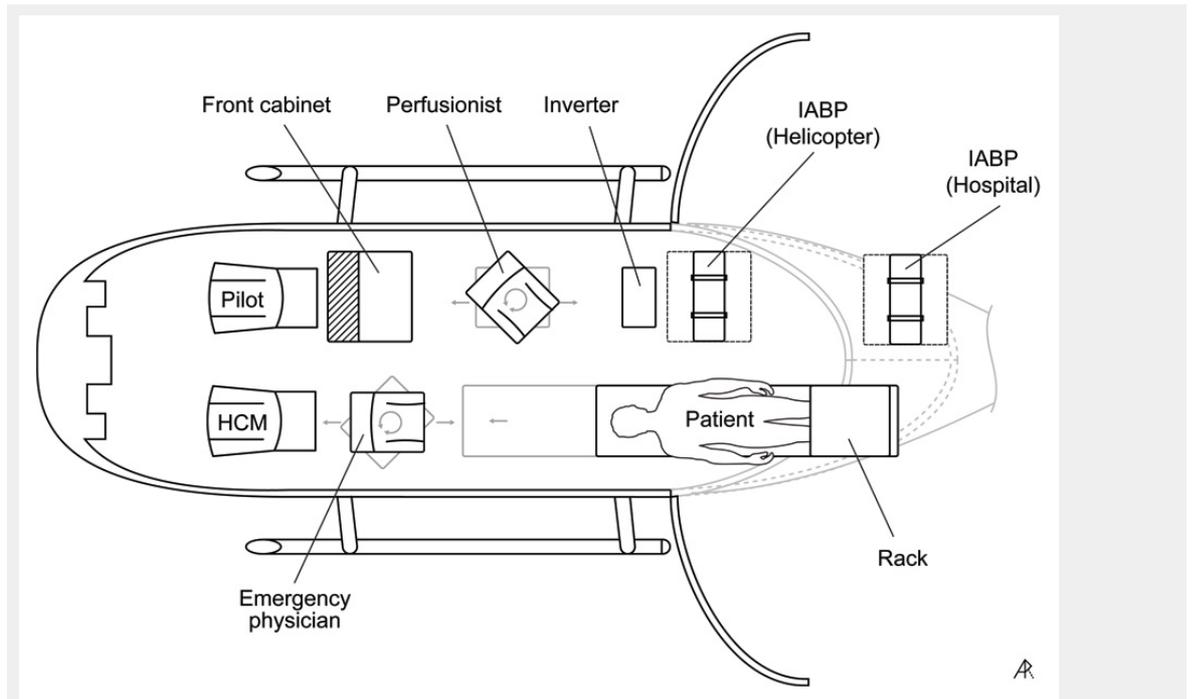


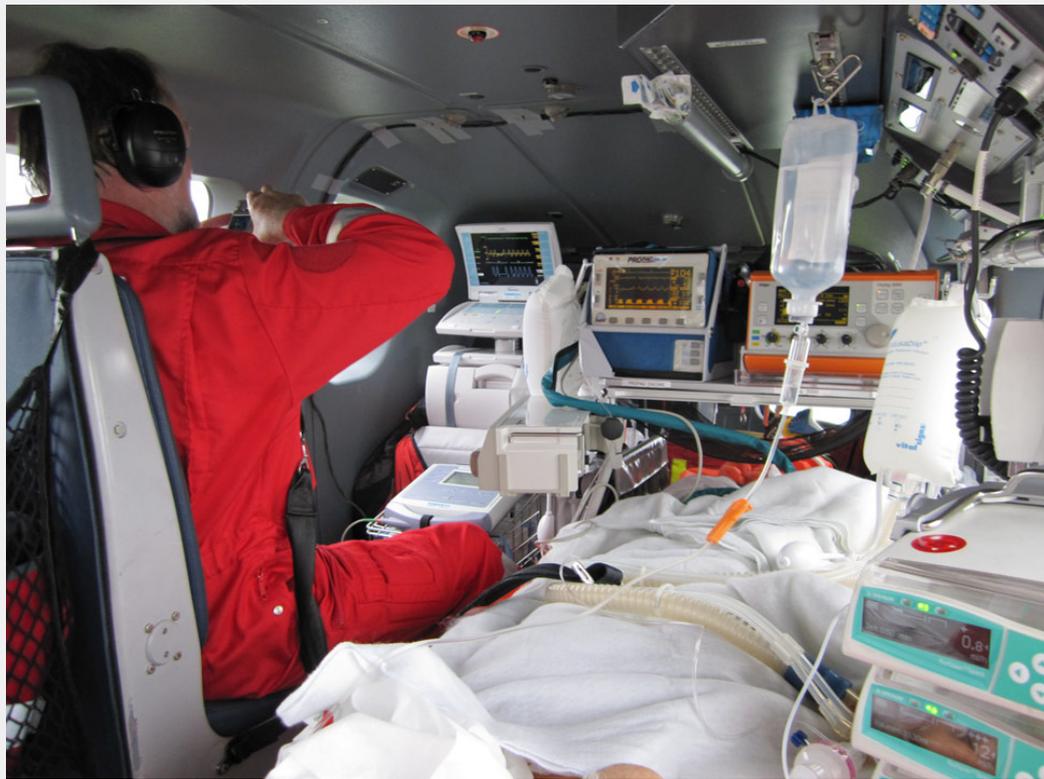
Figure 1

Positioning of patient, crew members and specific devices within the helicopter (back doors open). HCM: Helicopter Emergency Medical Services Crew Member; IABP: Intra-aortic balloon pump.



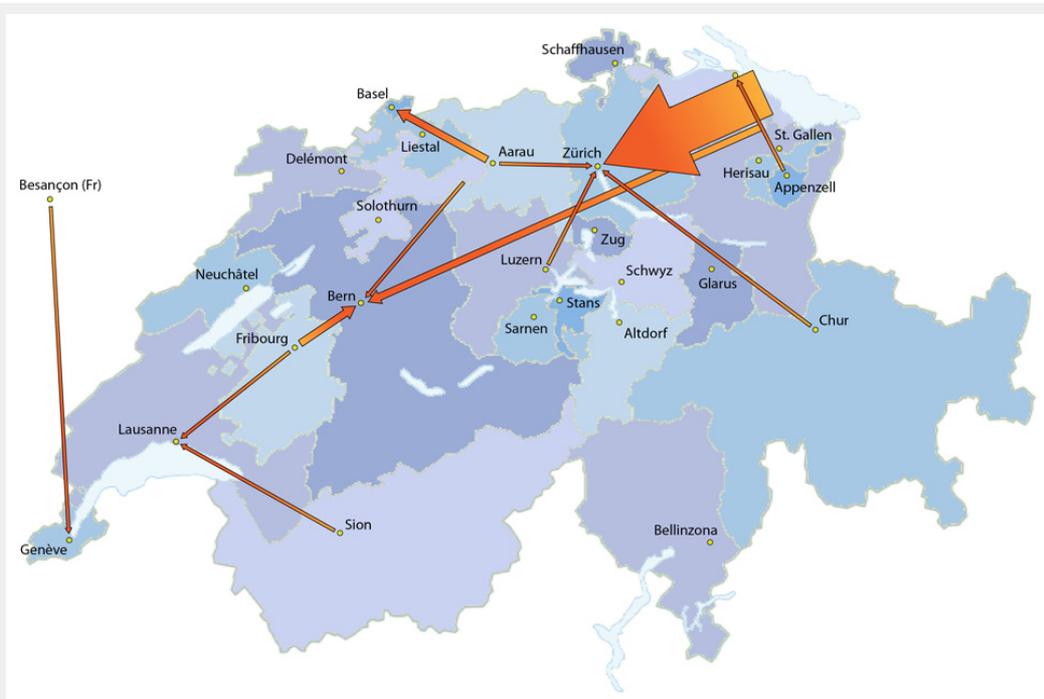
Figure 2

IABP switch occurring on the helipad.



**Figure 3**

Rear cabin of the EC145 showing dimensions and available space when occupied by a patient and Rega team, including a perfusionist.



**Figure 4**

Geographical distribution of patient transfers in Switzerland. Transfers within France and Germany are not shown. Arrow size is proportional to the number of transfers. Thin arrows represent the transfer of 1 patient; arrows twice this width represent transfer of 2 patients; the large arrow from eastern Switzerland to Zurich represents the transfer of 21 patients.