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Interhospital transport of the critically ill patient

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Chapter 8

Summary and future perspectives

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Summary

This thesis describes different aspects of the transfer of the critically ill patient by a mobile intensive care unit with a specialized retrieval team. While setting up our own MICU service we realized the paucity in literature about this topic. However, although there are not many well performed prospective studies, there are many retrospective observational studies and there is a lot of expert opinion. The lack of well performed prospective studies is understandable for several reasons.

Firstly, it will be very difficult to prove the value of a MICU with retrieval team compared to standard transports, looking at a primary outcome like mortality reduction. Changes made to a patient's condition by the type of transfer over such a short period of time compared to an ICU stay of much longer duration will probably only rarely result in a changed mortality.

Secondly, there are too many variables to take into account. There are different hospitals, different diseases and different severities of illness. Furthermore, to determine the value of MICU and a retrieval team, one should also compare the availability of specific equipment, the composition of the accompanying team and whether or not they received transport training. If so, what kind of transport training they received.

Thirdly, with the evidence available, it will be hard to pursue a medical ethical committee to get approval for studying the transfer an extreme critically ill patient with and without MICU equipment and retrieval team. Therefore, within this niche of critical care medicine, research is difficult. How does this thesis contribute to the existing knowledge?

In **chapter 2** we give an overview of all relevant aspects of transferring the critically ill patients. After reviewing the literature of the last four decades, we determine where we are today and what still has to be done. We present recommendations to improve both the transfer of critically ill as well as the transfer organization.

In **chapter 3** we studied 74 transports after starting our MICU service. We looked for incidents and changes in predetermined variables. We compared the results with data gathered in 2005 before the introduction of our MICU service. The conclusion was that sicker patients were transferred with less adverse events, proving the value of a MICU service with retrieval team.

In **chapter 4** we analyzed all technical problems encountered during a period of 30 months. We showed how they influenced the transfers and how they could be anticipated. We concluded that most of these technical problems could be resolved with some technical understanding of the equipment used. Therefore, we emphasized not only transport specific training is necessary, but also implementing knowledge of the technical background of the equipment used.

In **chapter 5** we described our training program. First, we determined 5 pivotal aspects of a transport specific training: preparation, teamwork, new equipment, mobility and safety.

Thereafter, by using crew resource management principles we set up our own simulator-based scenario training. Furthermore, we described improvements we made along the way, based on experiences from the field. It is the first published specific transport training, with a detailed description of the training.

In **chapter 6** we studied the regional impact of the MICU. In the Netherlands, there are three different levels of ICU. Level 1 provides basic ICU care without 24-hr supervision of an intensivist. Level two provides the more sophisticated level ICU care with 24-hr supervision by an intensivist. Level 3 provides the highest level of ICU care, quite often of an academic level. In general, there are three reasons for transferring a patient: additional therapy not available at the hospital of origin, a shortage of ICU beds and patients transferred back to a hospital nearby their home either because of social reasons or because they have been stabilized and therefore do not need the higher level ICU care anymore.

In this chapter we studied if patients ended up at the correct level ICU considering the primary reasons for transfer. We concluded that patients transferred for additional therapy almost always were transferred to a higher level ICU and contrary, patients transferred back, almost always ended up at a lower level ICU. Patients transferred because of the unavailability of an ICU bed were transferred to higher, same and lower level ICU's equally. Although we did not compare these results with the situation before the start of our MICU service, we concluded that a MICU service might be valuable for a better regional ICU occupancy. Furthermore, after estimating the costs of this service, it is obvious that the present financing system is not sufficient to sustain a MICU service in the long run. Finally, we determined the mortality of all transferred patients 6 months after transfer. Especially the mortality (43%) of the group transferred for additional therapy seems high, but is within the range of urgent medical ICU admissions in general.

In **chapter 7** we studied the observed changes in blood pressure which occurs concurrently with acceleration and deceleration during MICU transports. Since blood pressure changes did not always seem to have the same amplitudes, we aimed to find out whether patient characteristics were involved or that changes were caused by a physical measurement artifact. In an experimental setting we found out the phenomenon is mainly caused by the distance between arterial cannula and pressure transducer. Interestingly, it is also partially explained by the amplitude of the mean arterial pressure. The influence of acceleration on blood pressure is greater if the length of the pressure line is greater and if the mean arterial pressure is higher. In a patient setting we confirmed that this phenomenon is mainly a physical measurement. For example when the pressure transducer is placed on top of the arterial cannula, there is almost no correlation between acceleration and blood pressure. If the pressure transducer is placed at its normal position, in general 100 - 150 cm away from the arterial cannula, there is significant correlation. This emphasizes that transportation has its own difficulties making the care for the already complicated critically ill patients even more complicated. Clinicians involved in transportation should be aware of this.

Future perspectives

Two main questions still need to be answered.

Firstly, should an intensivist always be part of the retrieval team? In our opinion, preparation is one of the most important items involved in a safe transport. There is a need for an experienced physician, who is also able to anticipate on possible problems. Furthermore, since back-up is not available on the spot, accompanying a transfer is not recommended for a resident. Thus, in our opinion, an intensivist should be part of the team.

Secondly, which patients should be transferred by a MICU and retrieval team? All ICU patients or just the patient dependent on a ventilator or on hemodynamic support? The Dutch regulations with its own arbitrary indications (i.e. MICU transfer is only allowed above certain ventilator settings) seem to work, although this has not been investigated properly. However, one of the potential disadvantages of these regulations might be a lack of transport exposure of local intensivists, increasing the risk of incidents for non-MICU transports. This disadvantage, combined with our findings of technical problems during transports, make it justifiable to broaden the limits and transfer even more ICU patients, by a Mobile Intensive Care Unit.

Of course, this will increase the amount of transports performed by MICU, increasing the quality of ICU transfers in general. Furthermore, due to the inadequate financing system we have at the moment, an increase in the amount of transports will also mean that MICU services will more likely be available in the future as well: As we have shown, the costs are mainly fixed costs, determined by the personnel standing by for potential transfers. However, payments are only done per transport and there is no financial coverage for being on standby. Broadening the limits for MICU transfer will therefore not only lead to a further improvement of the quality of transfers of the critically ill, from a financial perspective it might sustain its future as well.

Finally, the quality of the transfers of the critically ill patients has improved enormously since several MICU services started in 2009. At this moment, there is MICU service availability all over the Netherlands.

Unfortunately, trolleys are not interchangeable, there is not a standardized intake form, nor incident monitoring system. So we are on our way, but we aren't there yet.

