

# Fluid therapy in burns

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Outcome after burn injury, as also paralleled by other trauma, has been improving steadily over the years. In this aspect a significant improvement was seen especially in the 1970-ties when the 50% survival chance from a burn injury increased from 45% total body surface area burned (TBSA%) in a 21 year old patient up to almost 80% (TBSA%). Although this improvement may be claimed to have many reasons, a significant one that needs to be stressed is the introduction of more thorough use of protocolized fluid treatment strategies

**Key words:** fluid therapy, burns, survival

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Outcome after burn injury, as also paralleled by other trauma, has been improving steadily over the years. In this aspect a significant improvement was seen especially in the 1970-ties when the 50% survival chance from a burn injury increased from 45% total body surface area burned (TBSA%) in a 21 year old patient up to almost 80% (TBSA%). Although this improvement may be claimed to have many reasons, a significant one that needs to be stressed is the introduction of more thorough use of protocolized fluid treatment strategies. Although several schemes were launched at the time, in different parts of the world, the crystalloid based formula suggested by Dr. Baxter was the one which obtained the largest international spread. Although the underlying work for the development of this strategy was done already in the end of the 1960-ties, it is still the most commonly used fluid resuscitation regiment for burn injuries worldwide. Also, despite that more than 40 years have passed, no better fluid resuscitation strategy for burns

has yet been presented. The Baxter formula, often called the “Parkland formula” as it was invented at the Parkland Memorial Hospital in Dallas, Texas, states that 2–4 ml/kg/TBSA% should be provided as fluid resuscitation, as a guideline. The fluid volume provided should thereafter be adjusted according to urine output, aiming at a urine output of 30–50 ml/h. At the beginning of the use of this fluid therapy, fluid volumes given were in the lower range, i. e. more often 2 than 4 ml, but more recently, during the last 10 years, a shift has been made towards providing larger fluid volumes, often surpassing the upper range, i. e. 4 ml/kg/TBSA% as stated by the Parkland formula. This change to providing larger fluid volumes has been called the “fluid creep” and has been a matter of intense debates. Many experienced burn care physicians have claimed the change to be unfavorable for outcome, although a worse outcome has not yet been presented, although new complication entities, such as abdominal compartment syndrome, have been claimed to be among the complications that have appeared due to larger fluid volumes provided. Factors thought important for the “fluid creep” effect were as follows: inappropriate use of central

circulatory surveillance parameters guiding fluid therapy instead of using urine output; excessive use of ventilator support, and indirectly to large effects of opioids and sedation. Recent studies examining the Parkland strategy using detailed central circulatory surveillance techniques (PAC catheters; PiCCO system and Echo Cardiography) have shown that the Parkland strategy leads to a controlled hypovolemia for the first 12 hours post burn and isovolemia is reached first in 24 hours and in 36 hours there seems to be almost a hypervolemic situation (1). The early hypovolemia period is called “permissive hypovolemia”. The finding that there is an early hypovolemia period followed by a normovolemic situation and a period thereafter with hypervolemia has led to the idea that the fluids are administered too slowly and the bulk of the fluid volume is provided too late (2). This is also supported by in vitro findings that the negative imbibition pressure, that is known to be the driving force of the fluid loss, seen in burn injured tissue, has its maximum (e. g., minimum at 150 mm Hg) in two hours post burn and most of its effect is over in 6 hours post burn. Interestingly, recent studies based on the concept of “fluid responsiveness” in estimating fluid needs post burn have shown that less fluid is needed in burn shock resuscitation as compared to the needs predicted by central circulation endpoints. The levels suggested by PPV (pulse pressure variation) and SVV (stroke volume variations) estimates are more close to those seen using urine output as the endpoint and the volume provided is in the lower range of the “Parkland” prediction.

In parallel to these crystalloid based strategies, investigations have been made based on colloid regimens as well. From an outcome perspective these have not been found better although a significant finding has been that using colloids in the resuscitation leads to less fluid provided. However, the fluid volumes saved have yet been found minor and therefore the enthusiasm has been restricted.

In summary, a lot of work has been directed towards finding a better fluid resuscitation strategy for burns than the Parkland formula presented in the late 60-ties. However, as of yet no better fluid strategy has been presented and the “Parkland” concept still holds. One late conclusion is though that significant focus and attention need to be di-

rected to urine output surveillance so that the risk of over resuscitation is reduced.

As no or little progress may be claimed to have occurred beyond the Parkland concept for 40 years, it suggests that the focus for the future should not be to try to improve this fluid strategy any further but rather to try to block the mechanisms leading to the large fluid shifts seen in burns. This road has been attempted before and there are some promising results. Possibly this may be the future direction for improving fluid resuscitation for burn shock.

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## Folke Sjöberg

### SKYSČIŲ TERAPIJA NUDEGIMŲ ATVEJ AIS

#### *Santrauka*

Išeitys po nudegimų, kaip ir po kitų traumų, bėgant metams stabiliai gerėja. Šiuo aspektu reikšmingas pagerėjimas užfiksuotas 1970-aisiais, kai išgyvenamumo tikimybė po nudegimo padidėjo 50 %: nuo 45 % bendro nudegusio kūno paviršiaus ploto (BNP %) 21 metų amžiaus pacientų iki beveik 80 % (BNP %). Nors šį pagerėjimą galėjo lemti daugelis priežasčių, viena svarbi priežastis, kurią reikėtų pabrėžti, yra nuoseklesnių protokolizuotų skysčių terapijos strategijų įdiegimas.

**Raktažodžiai:** skysčių terapija, nudegimai, išgyvenamumas