

swiss trauma & Resuscitation Days  
28th February 2014, Bern

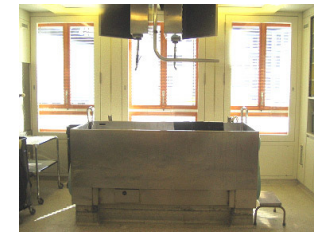
## Initial evaluation and management of the burn patient

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## Contents

- Pathophysiology
- Primary care - on site
- Primary care – hospital
- Fluid management
- Burn center



Not:

- Burn wound surgery



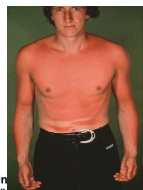
Chemicals



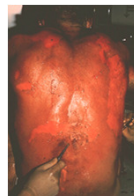
Electricity



Sunburn



Scald/Fire



Lightning

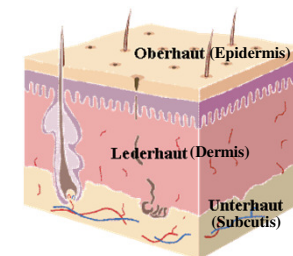


## The Skin

Biggest human organ

Surface 1,5 to 2 m<sup>2</sup>

1/6 of body weight



## Pathophysiology - Skin

### Protection:

- mechanical, thermal, chemical
- UV, Microorganism

### Immunologic:

- Antigene/antibody

### Regulation:

- liquidity, protein, electrolyte

### Thermoregulation:

- Vasoconstriction-/dilatation

### Endokrinology:

- Vit. D3 synthesis

### Somatovisceral sensibility:

- Temperature, mechanical stimulus, pain

## Pathophysiology - Thermal Damage

### Extent of damage

Time  
Temperature  
Localisation  
Patient factors

Temperature **> 52° C**

Protein Denaturation

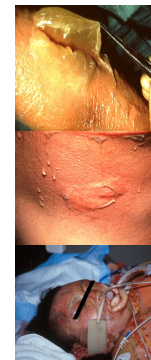
Vessel Permeability

## Pathophysiology



**Fluidshifting**  
**Fluidloss**

## Pathophysiology



### Exsudation

3 Liter H<sub>2</sub>O/m<sup>2</sup>

Plasma

### Evaporation

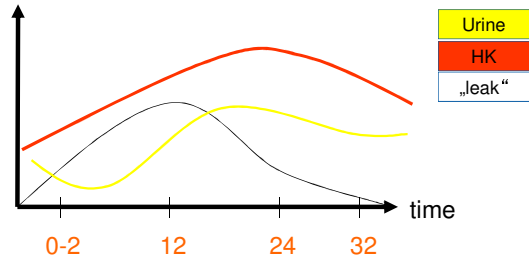
4 Liter H<sub>2</sub>O/m<sup>2</sup>

### Edema

Up to 15% body  
weight

## Pathophysiology

Monitoring: Clinically, hematocrit, urine output



→ Urine/h and HK

## Primary care – on site

### Self protection

Vital parameters (ABCD, Fluid management)

Concomitant injuries

Wound assessment (surface)

Cooling

Wound protection

Triage

## Primary care

Self protection

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## Primary care

Self protection

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## Primary care

Concomitant injuries (3-5%)

- **Inhalation**
- **fracture**
- **Cranio cerebral injury**
- Inner ear/eardrum
- Eyes

High Voltage  
Explosion  
Car accident

## Primary care

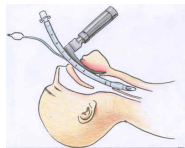
Soot Carbon dioxide Carbon monoxide Acid  
Aldehyde Nitrogen oxide

Inhalation



**Inflammation > edema > ARDS**

## Primary care



### Indication Intubation

• **Absolute:**

- Coma
- Circular neck burn

• **Relative:**

- Acute inhalation injury

## Primary care

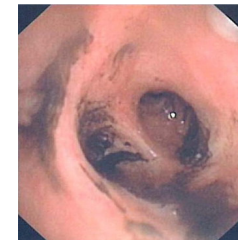
### Signs for acute inhalation injury

Indirect:

- Burned face
- Charred vibrissae
- Cough
- Soot traces

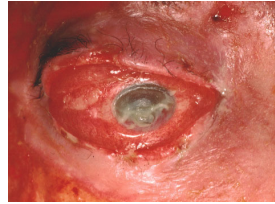
Direct

- Bronchoscopy



## Primary care

Eyes



## Primary care

Self protection

Vital parameters (ABCD, Fluid management)

Concomitant injuries

**Wound assessment (surface)**

Cooling

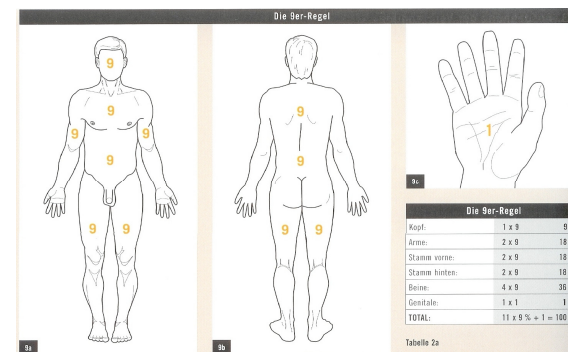
Wound protection

Triage

## Burn assessment - depth

Initially not important to assess depth of the burn...

## Burn assessment - extent



## Burn assessment - extent



Age  
+  
TBSA  
>100

Poor prognosis

ABSI-Score	
Bestandteil	Punkte
Sex	
Mann	1
Frau	2
Alter	
0-20	1
21-40	2
41-60	3
61-80	4
81-100	5
Inhalations trauma	1
III° Verbrennungen	1
KOP (%)	
1-10	1
11-20	2
21-30	3
31-40	4
41-50	5
51-60	6
61-70	7
71-80	8
81-90	9
91-100	10

Tabelle 5

## Primary care

Self protection

Vital parameters (ABCD, Fluid management)

Concomitant injuries

Wound assessment (surface)

**Cooling**

Wound protection

Triage

## Primary care

Cooling – NOT freezing



Tap Water 12-16 ° C  
max. 15 min  
Remove wet clothes!

No ice!



## Primary care

Self protection

Vital parameters (ABCD, Fluid management)

Concomitant injuries

Wound assessment (surface)

Cooling

**Wound protection**

Triage



## Primary care

### Dressing?

- Removal of wet clothes
- Protection
- **Rescue blanket**



## Primary care

Self protection

Vital parameters (ABCD, Fluid management)

Concomitant injuries

Wound assessment (surface)

Cooling

Wound protection

**Triage**



## Triage/ Transfer

ambulant



Center

Peripheral  
hospital



## Triage/ Transfer

### Ambulant

- I°
- II° < 10% TBSA
- Young

### Peripheric Hospital

### Center

- > 20% TBSA
  - Acute inhalation injury
  - Electricity
  - < 3 years
  - > 70 years
- } >10% TBSA
- Deep burns to face, hand, urogenital

## Primary care - hospital

### Fluid management



#### On site

- Intravenous peripher

„let drop“

Urine: 60-80ml/h

#### Hospital

- Central venous catheter

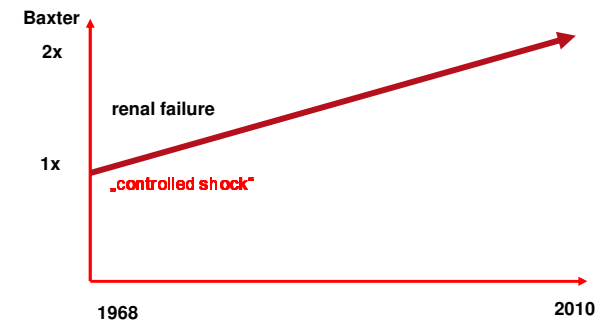
Baxter formula

## Resuscitation, fluid management and hemodynamics.

- Baxter Parkland Formula
- Experiments on Rhesus monkeys
- Capillary leak, peak at 12- 18 hrs.
- Volume drains into „third space“
- Substitution first 24hrs
- 4ml/kg/%TBSA Ringer' s lactate
- 50% first 8hrs
- 50% following 16hrs

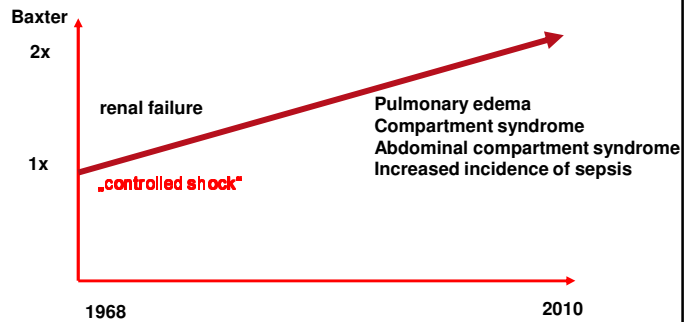


## Resuscitation, fluid management and hemodynamics.

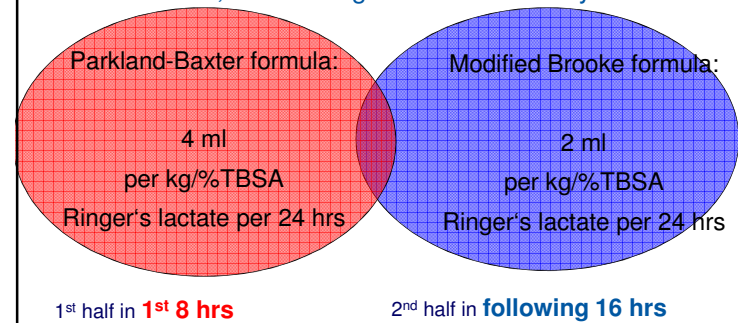




## Resuscitation, fluid management and hemodynamics.



## Resuscitation, fluid management and hemodynamics.



## Resuscitation, fluid management and hemodynamics.

- Baxter Parkland Formula
- Monitoring?
  - Cardiac Index
  - Pulmonary arterial catheter (PAC)
  - Central venous pressure (CVP)
  - Pulse Contour Cardiac Output (PiCCO)
  - Mean arterial pressure (MAP)
  - Serum Lactate
  - Urine output



## Resuscitation, fluid management and hemodynamics.

- PiCCO and PAC

Table 1. Crystalline fluid administration in studies using invasive hemodynamic monitoring for guidance of resuscitation<sup>a</sup>

Ref.	Study design	No. of patients	Burned body surface area (%) (mean values)	Hemodynamic monitoring	Administered fluid (ml/kg/BSA/24 h)
[14]	NR	22	32	PAC	4.3 <sup>b</sup>
[9]	NR	53	40	PAC	5.0 <sup>b</sup>
[9]	NR	30	42	PAC	6.0 <sup>b</sup>
[15]	NR	9	45	PAC	7.3 <sup>b</sup>
[18]	NR	24	45	TPTD	9.2

<sup>a</sup>PAC, pulmonary artery catheter; TPTD, transpulmonary indicator dilution; NR, nonrandomized.  
<sup>b</sup>By 70 kg body weight.

→ Results in increased fluid substitution (2x Baxter !!)

## Resuscitation, fluid management and hemodynamics.

- PiCCO and PAC
- Mortality unchanged
- No evidence for use in burn patients
- Higher morbidity (edema)

## Resuscitation, fluid management and hemodynamics.

- MAP = 70mmHg

## Resuscitation, fluid management and hemodynamics.

- Urine output
- Aim for 0.5ml/kg/h (adults)  
(i.e. 80kg patient: 40ml urine/h)
- Aim for 1ml/kg/h in children and 2ml/kg/h in infants

## Primary care - Hospital

### Bronchoscopy



- Grade I: Hyperemia, Edema  
Grade II: + Ischemia haemorrhage blister  
Grade III: + Ulcerationen necrosis



Intubation, PEEP

## Primary care - Hospital

No surgical emergency intervention!

besides

**Escharo-/Fasciotomy**



## Primary care - Hospital

### Escharotomy/ Fasciotomy

On site

No



Hospital

Yes



## Primary care - Hospital

### Escharotomy/ Fasciotomy

Circular III\*

Parasthesia and numbness

Low arterial perfusion

Flexioncontracture (Highvoltage)

Respiratory failure with neck- und thoracic burns



## Primary care - Center

Triage

- ER or directly OR

Criteria:

- Concomitant injuries
- Extent of burn

Aim for early necrectomy



## „HOT TOPICS“

Tetanus prophylaxis: **always**

Prophylactic antibiotics: **never**

**No** tannic antiseptics (e.g. Betadine)

## Take Home Messages

### On site:

- Self protection
- ATLS principals
- Cooling, not freezing

### Peripheric Hospital:

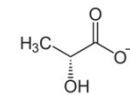
- ATLS principals
- <10%: Debridement, Treatment after Reevaluation after 24h
- >10-20%: Transfer to Center

# Thank you very much



## Resuscitation, fluid management and hemodynamics.

- Serum lactate increased in first 24hrs
- Decreased hepatic lactate clearance (CI and liver perfusion low)
- Increased lactate production in burns
- Possible hypovolaemia



## Resuscitation, fluid management and hemodynamics.

- Serum lactate increased in first 24hrs
- Does fluid increase lower serum lactate?

		Baxter	1.8 x Baxter	
Lactate (mmol/l)	T <sub>1</sub>	4.2 (±2.6)	3.9 (±1.9)	NS
	T <sub>2</sub>	6.2 (±3.7)	5.4 (±4.2)	NS
	T <sub>3</sub>	4.8 (±2.9)	4.1 (±3.3)	NS
	T <sub>4</sub>	2.7 (±1.2)	3.2 (±2.5)	NS
	T <sub>5</sub>	2.3 (±1.6)	3.3 (±3.5)	NS



Lactate in first 24 hrs does not correlate with volaemia!

## Resuscitation, fluid management and hemodynamics.

- Initial serum lactate in severe burns at 5-10mmol/l „normal“
- Lactate should show tendency to decrease
- If serum lactate increases:  
Increase fluid substitution by 50%/hr
- Serum lactate should normalise only after the first 24hrs



## Resuscitation, fluid management and hemodynamics.

- Serum lactate **AFTER** first 24hrs
- Serum lactate > 2mmol/l indicates hypovolaemia
- Conclusion:
- < 24h: Increased lactate **does not** indicate hypovolaemia
- > 24 h: Increased lactate **does** indicate hypovolaemia