

FIRE IN CARS – some medical aspects

**Senior Professor Ulf Björnstig
Department of Surgery;
Umeå university, Umeå
2020**

Traffic Injury Prevention (2013) **14**, 823–827
Published with license by Taylor & Francis
ISSN: 1538-9588 print / 1538-957X online
DOI: 10.1080/15389588.2013.777956



Car Crash Fatalities Associated With Fire in Sweden

ÅSA VIKLUND¹, JOHANNA BJÖRNSTIG², MAGNUS LARSSON^{1,3}, and ULF BJÖRNSTIG²

¹*The Swedish Transport Administration, Luleå, Sweden*

²*Department of Surgery/KBC, Umeå University, Umeå, Sweden*

³*Norwegian Public Roads Administration, Region East, Lillehammer, Norway*

Received 4 October 2012, Accepted 16 February 2013

RESULTS

- During the 11- years 1998-2008 a total of 181 people died in post crash fires - 64% drivers
- 5 – 8 % of passenger car deaths

Dead by fire – 55 deaths **without** fatal traumatic injuries

- ▶ Drivers 25 (45%)
- ▶ Passengers 30 (55%)

Recent study 10 years later – 2009 - 2018

- ▶ 94 fatalities in a burning passenger car/10 year
- ▶ Autopsy:
 - ▶ 18 without traumatic fatal injuries
 - ▶ In 10 cases HCN (highly toxic) was detected

HCN produces when e.g. polyurethan is burning

E-vehicles – new problems ?



Fire emissions in vehicle fires – three physical effects

- ▶ Reduces oxygen in human cells
- ▶ Poisonous effect
- ▶ Corroding effect - airways



Low O₂-level in a human cell may be caused by:

- ▶ 1. Low O₂ level in the air (closed spaces) – the fire has consumed the O₂
- ▶ 2. CO
- ▶ 3. HCN

The effect adds up – suffocation of cells


2. CO- "poisoning".




- ▶ CO attach 250 times easier than O_2 to the hemoglobin in the red blood cells, and thus the transport of O_2 to the cells are blocked
- ▶ **Symtoms:** Head ache, nausea, decreased level of consiousness/ unconscious - and late neurologic and psyciatric symtoms < 14 days

The vicim may have a "false" cherry red colour – easy to misinterpret as a well oxygeneted person

3. HCN- "poisoning"

- ▶ HCN is a colourless, very toxic gas with lower density than air. Has been used in the gas chambers during WW II (Zyklon B)
 - ▶ HCN is quickly taken up in the cells, where HCN blocks the function of the mitochondries (the cell's power station) blocking the uptake of O₂ to the cell.
- 

SOME SYMPTOMS HCN

- ▶ 180 ppm fatal within 10 minutes
 - ▶ Taste/smell of bitter almond – taste of metal
 - ▶ Confusion, vomiting, dyspné (shortness of breath)
 - ▶ Convulsions
 - ▶ Muscle paralysis
 - ▶ Lung oedema
- 

Toxic substance of interest from fires in e-vehicle's (Li-ion) battery



Hydrogen fluorid (HF) or (PF5)

Air condition liquid and maybe also the cooling liquid of traction batteries (?) (R1234yf), generate HF when burning

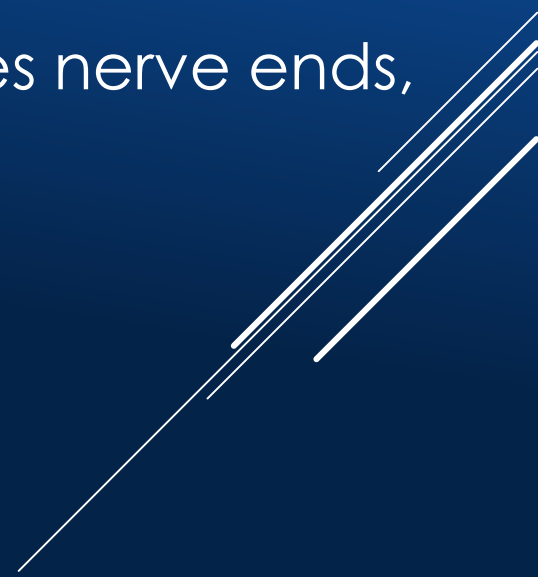
HF – (1) toxic, corrosive effect on airways/lungs



Medical effect :

- Irritating, pungent smell
- Causes corrosion in the airways because HF is a very strong acid – oedema and bleedings

HF – (2) toxic effect via changes in electrolytes in blood

- ▶ Reduction of the level of Ca^{++} (Calcium) in blood, which may induce heart arrhythmia (VES/ventricular extra systolic heart rhythm = dangerous)
 - ▶ Increased level of K^+ (potassium), irritates nerve ends, giving severe pain, often in the muscles
- 

Treatment at incident site – vehicle fire



1. Always O₂ – 100% if impaired consciousness, CPAP
2. If oedema and swelling in airways – quick intubation
3. If breathing compromised – give bronchus dilating drugs and steroids (reduces swelling) via the airway.

Treatment if HCN is suspected

4. Impaired consciousness - administer without delay **Cyanokit** infusion during 15-30 min – it will reverse the HCN block of the mitochondrias



Treatment – e.g. fire in e-vehicle's traction battery

5. Heart arrhythmia and/or severe muscle pain – administer tablet **Ca** 6 g – and to hospital
6. Low oxygenation - **intensive care** and/or pressure chamber



Thank you – two veterans – the youngest 50 yrs

