DROWNING, DRUGS AND ALCOHOL

WCDP 2011, Danang (Vietnam)
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University of Helsinki &
National Institute for Health and Welfare, Finland
Population: 5,400,000
Lakes: 188,000
Coast-line: 1100 km
Inland water: 33,615 km²
Registered boat: 600-700,000
Swimmers: 500,000
1. High unintentional drowning rates

2. High medico-legal autopsy rates
1. HIGH UNINTENTIONAL DROWNING RATES


1. HIGH UNINTENTIONAL DROWNING RATES


2. HIGH MEDICO-LEGAL AUTOPSY RATES

- Act of the Inquest into cause of death (L459/73)
  - Death has not been caused by a disease or when during the last illness he/she has not been treated by a physician
  - Death caused or suspected to be caused by crime, accident, suicide, poisoning, occupational disease, or medical treatment
  - Death otherwise unexpected

<table>
<thead>
<tr>
<th></th>
<th>N/year</th>
<th>Medico-legal autopsies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall deaths</td>
<td>50,000</td>
<td>22%</td>
</tr>
<tr>
<td>Injury deaths</td>
<td>4000</td>
<td>92%</td>
</tr>
<tr>
<td>Drowning</td>
<td>250-300</td>
<td>99.9%</td>
</tr>
</tbody>
</table>
• Alcohol use is the major individual risk factor for drowning

• Most of the international studies: 25-50% of drowning are alcohol-related

**ALCOHOL-POSITIVE DROWNING (1998-2009)**

• Overall unintentional drowning 57.7%
  – Boating-related drowning 62.2%
  – Non boating-related drowning 55.7%
ALCOHOL-POSITIVE DROWNING (1998-2009)

DROWNING AND ALCOHOL

• MEDICAL LITERATURE

• PIONEER ARTICLES


  – Australia: Plueckhahn VD, The aetiology of 134 deaths due to "drowning" in Geelong ... Med J Aust. 1972
ALCOHOL AND DROWNING

• MEDICAL LITERATURE

• REVIEW ARTICLES


DROWNING AND ALCOHOL

• MEDICAL LITERATURE

• ARTICLES IN FOCUS

  – National
  – Regional
  – Jurisdiction

  PubMed search with “drowning” and “alcohol”: 293 articles
DROWNING AND ALCOHOL

• ALCOHOL AS A RISK FACTOR FOR DROWNING
  1. Fall into water in different settings
  2. Swim or boating in dangerous situation
  3. Operate a boat improperly
  4. Hamper decision-making regarding safety
  5. Decrease the capacity to swim or resist cold in water

DROWNING AND OTHER DRUGS

• MEDICAL LITERATURE:

Drowning

Alcohol

Other drugs?
MATERIAL AND METHODS

- Setting: Finland, 2000-2009
- Helsinki Department of Forensic Medicine, Toxicological Laboratory database
- Selection criteria: ICD-10 nature of injury code for drowning: T75.1

MATERIAL AND METHODS

- 5 UNIVERSITY FORENSIC MEDICINE DEPT.
- 15 HOSPITALS, MEDICO-LEGAL AUTOPSY
MATERIAL AND METHODS

- 7000 POSTMORTEM TOXICOLOGICAL ANALYSIS
- 2500 MEDICO-LEGAL AUTOPSIES
- 2900 CLINICAL FORENSIC EXAMINATIONS

MATERIAL AND METHODS

A. Rapid alcohol screening (QED) cerebral liquid
MATERIAL AND METHODS

1. Blood
2. Vitreous humour
3. Urine
4. Other tissue/liquid

ALCOHOLS

PRESCRIPTION DRUGS

DRUGS OF ABUSE

GC, TLC, OPLC, LC-DAD, LC-CLND, GC-MS, GC-FTIR, LC-MS/MS, LC-TOFMS
### MATERIAL AND METHODS

<table>
<thead>
<tr>
<th>ATC codes (Anatomical Therapeutic Chemical classification)</th>
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<tr>
<td><strong>N central nervous system</strong></td>
</tr>
<tr>
<td>– N01 Anesthetics</td>
</tr>
<tr>
<td>– N02 Analgesics</td>
</tr>
<tr>
<td>– N03 Antiepileptics</td>
</tr>
<tr>
<td>– N04 Anti-Parkinson drugs</td>
</tr>
<tr>
<td>– N05 Psycholeptics</td>
</tr>
<tr>
<td>– N06 Psychoanaleptics</td>
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<th>Other drugs</th>
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RESULTS

<table>
<thead>
<tr>
<th>Drowning</th>
<th>N</th>
<th>% tested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>alcohol</td>
</tr>
<tr>
<td>All</td>
<td>2828</td>
<td>100%</td>
</tr>
<tr>
<td>unintentional</td>
<td>2058</td>
<td>100%</td>
</tr>
<tr>
<td>suicide</td>
<td>547</td>
<td>100%</td>
</tr>
<tr>
<td>homicide</td>
<td>11</td>
<td>100%</td>
</tr>
<tr>
<td>undetermined</td>
<td>208</td>
<td>100%</td>
</tr>
</tbody>
</table>

RESULTS

Alcohol 51.3%
Psychotropic Drugs 31.4%
Alcohol/ Psychotropic drugs 18.2%
Other Drugs 10.5%
All drowning N=2828
RESULTS - ALCOHOL

Alcohol-positive (BAC ≥ 0.5‰) drowning, ≥15-years

%  
70  
60  
50  
40  
30  
20  
10  
0  
Unintentional  Boating  Non-boating  Other  Suicide  
58.3%  65.5%  61.6%  28.2%  32.7%

RESULTS - ALCOHOL

Alcohol-positive (BAC ≥ 0.5‰) drowning, 15-years

%  
70  
60  
50  
40  
30  
20  
10  
0  
Unintentional  Suicide  Overall drowning  
60%  39.5%  57%  48%  24.7%  37%

Males  Females
RESULTS - ALCOHOL

Unintentional drowning, by BAC (‰) groups

• Ante-mortem alcohol consumption
  vs.
• Post-mortem alcohol production
• Ante-mortem alcohol consumption vs. post-mortem production

Important
blood + urine + vitreous humour samples!

Blood
Alcohol

Urine
Alcohol

Vitreous humour
Alcohol

Exclusion of post-mortem alcohol production

• Ante-mortem alcohol consumption vs. post-mortem production

Important
blood + urine + vitreous humour samples!

Blood
Alcohol

Urine
No alcohol

Vitreous humour
No alcohol

Post-mortem alcohol production
### RESULTS – PSYCHOACTIVE DRUGS

#### Psychoactive drugs (n=922)

<table>
<thead>
<tr>
<th>Number of Drowning Victims</th>
<th>Number of Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>351</td>
<td>1</td>
</tr>
<tr>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td>158</td>
<td>3</td>
</tr>
<tr>
<td>92</td>
<td>4</td>
</tr>
<tr>
<td>37</td>
<td>5</td>
</tr>
<tr>
<td>34</td>
<td>6 to 9</td>
</tr>
</tbody>
</table>

### RESULTS – PSYCHOACTIVE DRUGS

#### 83 different psychoactive drugs

<table>
<thead>
<tr>
<th>Drug</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazepam</td>
<td>239</td>
</tr>
<tr>
<td>Oxazepam*</td>
<td>258</td>
</tr>
<tr>
<td>Temazepam*</td>
<td>239</td>
</tr>
<tr>
<td>Citalopram</td>
<td>131</td>
</tr>
<tr>
<td>Zopiclone</td>
<td>81</td>
</tr>
<tr>
<td>Chlordiazepoxide</td>
<td>61</td>
</tr>
<tr>
<td>Olanzapine</td>
<td>51</td>
</tr>
<tr>
<td>Carbamazepine</td>
<td>36</td>
</tr>
<tr>
<td>Alprazolam</td>
<td>32</td>
</tr>
<tr>
<td>Amitriptyline</td>
<td>28</td>
</tr>
<tr>
<td>Tramadol</td>
<td>23</td>
</tr>
</tbody>
</table>
RESULTS – PSYCHOACTIVE DRUGS

Drowning associated with psychotropic drugs, ≥15-years

Unintentional: 25.7%
Boating: 14%
Non-boating: 31.3%
Suicide: 64%

RESULTS – PSYCHOACTIVE DRUGS

Drowning associated with psychotropic drugs, ≥15-years, by sex

Unintentional: Males 24.8%, Females 29.8%
Suicide: Males 75%, Females 55.5%
Overall drowning: Males 30.5%, Females 54.5%
RESULTS – ALCOHOL/PSYCHOTROPIC DRUGS

Drowning associated with alcohol and psychotropic drugs ≥15-years

- Unintentional: 18%
- Boating: 10,4%
- Non-boating: 21,8%
- Suicide: 24,7%

RESULTS

Unintentional drowning, % of positive cases by age groups

- Alcohol
- Drugs
- Alcohol-drugs
HOW TO EVALUATE THE EFFECTS OF DRUGS?

degree of psychomotor impairments caused by different drugs

studies on driving under the influence of alcohol and drugs

limitations but most objective criteria available

EFFECTS OF DRUGS: SCORING SYSTEM

• Grade 0: no effects  BAC = 0,0‰
• Grade 1-2: unprobable  BAC = 0,0‰
• Grade 3: no definite  BAC = <0,5‰

• Grade 4: possible  BAC = 0,5-1.1‰
• Grade 5: probable  BAC = 1.2-2.0‰
• Grade 6: very probable  BAC = > 2.0‰
EFFECTS OF DRUGS: SCORING SYSTEM

• Blinded by two expert toxicologists

• For each case, score (0-6) for
  1. alcohol
  2. every single drug
  3. overall drugs
  4. alcohol and drugs

• Divergent scores
  – Consensus meeting
RESULTS

Unintentional drowning alcohol and psychotropic drugs, by score

<table>
<thead>
<tr>
<th>Score</th>
<th>Alcohol</th>
<th>Psychotropic drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>1-3</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>4-6</td>
<td>10%</td>
<td>90%</td>
</tr>
</tbody>
</table>

RESULTS

Unintentional drowning, psychotropic drugs in alcohol-negative cases

- Negative for drugs: 44.7%
- Psychotropic drugs: 27.8%
- Psychotropic drugs 4-6: 9.1%
RESULTS

ACCIDENTAL DROWNING, % OF CASES WITH PSYCHOTROPIC DRUGS (SCORE 4-6), BY BAC

FUTURE STEPS

1. Statistical data assessment

2. Comparisons of these toxicological data with corresponding data on:
   - injury deaths due to other causes
CONCLUSIONS

1. Despite declines in drowning rates and various prevention programs, the drowning rates in Finland are still high

2. Finland has had much success in reducing alcohol- (and drug) related motor traffic accidents but ....
CONCLUSIONS

3. To reduce drowning rates to levels comparable to other HIC we must further address the issue of alcohol (and drugs?) use in aquatic settings.

4. The opportunity exists in Finland for scientific advancements in drowning research.

Psychoactive drugs are likely an unrecognised risk factor for unintentional drowning...

but do not forget the role of alcohol in adult drowning in LMIC

another unexplored and possibly underscored drowning-related issue
THANK YOU FOR LISTENING...

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