Traffic accident victims and polytrauma patients: injury patterns, outcome and their influencing factors

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INTRODUCTION

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General introduction, aim and outline of the thesis

Outcome and injury patterns after road traffic accidents

Road traffic accidents (RTA's) contribute significantly to the global burden of trauma. The World Health Organization indicates that approximately 1.3 million people die each year on the world's roads and between 20 and 50 million sustain non-fatal injuries[1].

The introduction of extensive traffic safety laws and extensive preventive governmental programs in The Netherlands resulted in a gradual decrease in road traffic injuries and fatalities in the 1990s and onward[2]. At the same time, the organisation of pre- and in-hospital trauma care changed dramatically. The Advanced Trauma Life Support (ATLS®) program provided a national guideline for the structured and systematic approach to the primary treatment of trauma patients[3]. This was followed in 1997 by the implementation of 11 regional trauma systems by the Dutch government, each of which contains one level I trauma center that provides the highest level of surgical care to trauma patients and is responsible for the trauma network and collaboration in that specific trauma region.

After decades of declining numbers of RTA fatalities, this number has stabilized at an annual average of 620 fatalities in 2015 and since then a slight increase was seen resulting in 661 road traffic-related fatalities in the Netherlands in 2019[4].

Also, despite government measures to improve road safety, the number of serious road traffic injuries has been increasing since 2006. In 2018, an estimated 21,700 people were seriously injured in traffic in the Netherlands, approximately 1,000 more than in 2017[4].

Nowadays, traffic conditions and demographics of road traffic participants are changing continuously. Especially in a densely populated country like the Netherlands, the roads are congesting more and more and motorized two-wheeled vehicles have become an efficient and more important alternative method of transportation. Compared to other motorized road users, such as cars, riders of motorized two-wheeled vehicles are more vulnerable and therefore at greater risk of sustaining severe injuries and death[5–8].

Elderly are over-represented in both RTA fatalities and seriously injured RTA participants. The ageing Dutch population and the increased desire for self-reliance and autonomy of older people will probably strengthen this trend. Although that seems a positive development, it can lead to more safety risks as older people remain more mobile and travel longer distances using more and different methods of transportation such as electric bicycles, mopeds and mobility scooters[9]. Thus, the number of mobility scooters in The Netherlands is expected to grow among this specific part of the population to around

600,000 in 2030[10]. With its low speed, the mobility scooter may seem relatively safe, but especially among older users, safe use of the vehicle can be affected negatively by chronic illnesses, polypharmacy and by changes in physical and cognitive skills[10-13]. Each year, around 1,200 people over 55 (of which more than half are over 75 years of age) visit Emergency Departments (ED) of Dutch hospitals for treatment after an incident with a mobility scooter[10].

Another challenge for road safety programs are traumatic brain injuries (TBI) and unfortunately, the incidence of both non-severe and severe TBIs is rising sharply, mainly as a result of RTA's[14]. The high mortality rates, disability and long-term loss of function as a result of TBI have a significant impact on national health systems[6]. Each year approximately 21,000 RTA victims are admitted to Dutch hospitals with severe injuries and of those 20% sustained TBI. Nevertheless little is known about the epidemiology and risk factors for TBI after RTA's[15].

Effect of alcohol on injury patterns

It is widely recognised that drunk driving is an important risk-increasing factor and contributes to many RTA fatalities. It can be assumed that the real number of alcohol-related road casualties is higher than reported in the official statistics. Previous research found that a weighted average of 21.8% among road deaths worldwide are alcohol-related[16]. In the Netherlands, an estimated 12% to 23% of the RTA fatalities were due to drinking and driving in 2015, which is in line with the worldwide average[17]. A strong correlation exists between alcohol intoxication and the increased risk of sustaining all types of injuries[18,19]. TBI is no exception, with elevated blood alcohol concentrations (BAC) being demonstrated in almost half of the trauma patients diagnosed with TBI in Europe[20]. Nonetheless, the influence of elevated BACs on the outcome of severely injured patients and the corresponding pathophysiological changes remain a controversial issue. Recent literature suggests a neuroprotective effect of alcohol on TBI[21-24], possibly resulting in lower mortality and morbidity rates compared to TBI patients without elevated BAC's [25]. Despite these controversies, only very few studies have addressed the influence of alcohol intoxication in general and specific levels of BACs on TBI pattern and severity.

Influence of severe injuries on quality of life

In the Netherlands, 20% of all trauma patients admitted to hospitals each year since 2014, result from road traffic accidents [26]. It is well known that trauma affects people of all ages, and causes the loss of a considerable number of life years due to premature death and large numbers of years lived with disability[27]. Due to the introduction of an all-inclusive trauma system and centralization of trauma care, more polytrauma patients survive their injuries, often resulting in long-term disabilities and severe deficits in

health-related quality of life (HRQoL). Thus, HRQoL has become an important outcome measure of current trauma care. Especially long-term effects on physical and mental health have been extensively reported in literature[28]. However, fatigue and reduced societal participation in polytrauma patients have not been previously reported on and also their association with reduced HRQoL has not been described in the literature.

Aim and outline of this thesis

Polytrauma and especially road traffic accidents often result in and contribute significantly to severe morbidity and mortality. The primary aim of this thesis is to analyse injury patterns, injury severity and mortality for different types of road traffic participants involved in accidents in the Netherlands. Secondly, the association between blood alcohol concentrations, TBI patterns and patient outcome was analysed. Finally, patient and injury characteristics associated with HRQoL, fatigue and societal participation in polytrauma patients were identified.

Chapter 2 gives an overview of injury patterns and injury severity of in-hospital deceased RTA victims in the Netherlands. **Chapter 3** aims to describe the influence of different types of motorized two-wheeled vehicles on the patients' injury severity and mortality upon hospitalization after accidents in the Netherlands. **Chapter 4** provides an analysis of injury patterns, injury severity and mortality among victims of motorized mobility scooter accidents in relation to the trauma mechanism and patient's age. **Chapter 5** analyses the incidence, risk factors, hospital triage and outcome of patients with severe traumatic brain injuries caused by road traffic accidents admitted to hospitals in the Trauma Centre West region. **Chapter 6** discusses the association of different levels of blood alcohol concentration with traumatic brain injury characteristics and outcomes. **Chapter 7** provides the connection between determinants for Health-Related Quality of Life, fatigue and societal participation in polytrauma patients. In **chapter 8** a discussion on the topics described above is presented, together with future perspectives and potential implications of the findings stated in this thesis.

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