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The risk for end-stage renal disease is increased after burn

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ABSTRACT

Objective: Acute kidney injury (AKI) commonly complicates burn. Recently, AKI has been suggested to be causally related to chronic end-stage renal disease (ESRD), but controversial data also exist. Our aim was to study the risk of ESRD after burn in a nationwide analysis.
Methods: All burn patients undergoing hospitalization between 1998 and 2011 were identified from the National Hospital Discharge Register, and the data were linked with the Finnish Registry for Kidney Diseases, which includes all individuals receiving chronic renal replacement therapy (RRT) in Finland.
Results: Altogether 41,179 adults were treated at hospitals for burns in Finland between 1998 and 2011. Of these, 86 had a diagnosis of AKI related to the burn. Forty-three burn survivors had ESRD and RRT initiated related to or after the burn. The overall risk for ESRD after burn was increased (standardized incidence ratio, SIR, 2.40, 95% CI 1.73–3.23) compared with the Finnish population. Standardized incidence ratio was 3.11 (95% CI 1.66–5.32) in women and 1.89 (95% CI 1.27–2.69) in men. Of these 43 patients, 38 had a specific non-burn-related diagnosis of ESRD identified in the registry, and ESRD was deemed unlikely to be directly related to the burn. In five patients, the diagnosis of ESRD was unknown cause of renal failure, and causality of the burn with ESRD was evaluated as plausible.
Conclusion: In conclusion, a significantly increased risk of ESRD was recorded after a severe burn. Our results do not support increased incidence of ESRD solely as a consequence of AKI due to burn, but burn may increase the risk of ESRD in patients with pre-existing chronic kidney disease.

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1. Introduction

Acute kidney injury (AKI) is a frequent complication following severe burn [1–4]. The risk for AKI among burn patients increases with older age, larger percentage of total body surface burned, sepsis, multiple organ dysfunction and nephrotoxic antibiotics [5–8]. In burn patients, AKI carries an additional risk of morbidity and mortality [9–11]. Mortality rates ranging from 14% to 100% are reported [3,4,9,12–14].

The pathophysiology of AKI in the setting of burn is most likely related to the longer duration of inflammatory response [15,16] rather than to the decreased renal perfusion [17]. That said, intra-abdominal hypertension and abdominal compartment syndrome due to excessive fluid resuscitation [18,19] or rhabdomyolysis [20,21] may also lead to development of AKI [22,23].

Long-term dialysis after burn AKI is rare [24]. Traditionally, recovery from AKI has been expressed as recovery of kidney function with improvement of urine output and glomerular filtration rate, and AKI survivors are considered to have an excellent long-term prognosis [25]. However, recent research challenges this concept and non-burn AKI survivors seem to be at heightened risk for chronic kidney disease (CKD) and progressive renal failure [26,27]. The purpose of this epidemiological registry linkage study was to investigate the occurrence of end-stage renal disease (ESRD) among a large national cohort of burn patients obtained from the National Hospital Discharge Register.

2. Materials and methods

The Helsinki University Hospital Internal Review Board approved the study protocol. Permission to use the register information in scientific research was obtained from the National Institute of Health and Welfare (THL) after consulting the data protection authority. Specifically, permission to identify burn adult patients from the National Hospital Discharge Register and the Finnish Registry for Kidney Diseases was obtained from THL.

The Finnish Hospital Discharge Register, a national health care registry maintained by THL National Institute for Health and Welfare, has been maintained data since 1960. The registry includes all inpatient care since 1967 and outpatient care in public hospitals since 1998. The register collects information on hospitalizations (day of admission and discharge), outpatient visit (day of visit), diagnoses given during the inpatient care (ICD-10 codes since 1996) and surgical procedure codes (NOMESCO Classification of Surgical Procedures since 1997).

The Finnish Registry for Kidney Diseases, a national health care registry maintained by the Finnish Kidney and Liver Association, has been maintained data since 1964. The registry has an estimated coverage of 97–99% of all dialysis and kidney transplantation patients in Finland. The coverage of FRKD has been estimated several times during the existence of the registry. The latest estimate was performed in the annual report of 2010 [28]. All patients whose dialysis treatment lasts at least three months are recorded in the registry. Hospitals report to the registry information concerning kidney disease, including start date of renal replacement therapy (RRT), kidney disease diagnosis, modality of RRT – hemodialysis, peritoneal dialysis or kidney transplantation – laboratory variables and cardiovascular comorbidities. After start of RRT, data are updated annually. Written informed consent and permission to use the data anonymously in registry reports and for research purposes were obtained from all patients upon their entering the registry.

The register linkages in this study were done using the personal identity code (PIC) as a key. All citizens and permanent residents in Finland have a unique PIC, which was introduced in 1964–1967. The PIC code is given already in the birth hospital, and it remains unchanged during an individual's life span. The PIC is used in all main registers in Finland and allows reliable deterministic record linkage. The PICs were replaced by a study code after the linkage.

Inclusion criteria for this register linkage study comprised patient age $\geq$18 years when the burn occurred, diagnosis with ICD-10 codes T20-T32.9 for burn and treatment in a hospital in Finland according to the National Hospital Discharge Register. The data of burn patients were reviewed to detect those who had been diagnosed with AKI before, during or after the burn accident with ICD-10 codes N17.0-N17.9 in 1.1.1998–31.12.2012. The cohort of burn patients was linked with the Finnish Registry for Kidney Diseases to identify all patients who were on chronic RRT before, during or after the burn. The causality between burn and ESRD was evaluated based on kidney disease diagnosis available in the Finnish Registry for Kidney Diseases and was recorded as either unlikely causality or plausible causality. The follow-up of the Finnish Registry for Kidney Diseases ended on 31.12.2013.

End-stage renal disease is defined as need for maintenance dialysis treatment for at least 3 months, or kidney transplantation. The incidence of ESRD is the number of patients with ESRD documented in the Finnish Register for Kidney Disease in relation to the total population of Finland at the same time period.

2.1. *Statistical analysis*

We calculated standardized incidence ratio (SIR) for the risk of ESRD after burn by using national rates from the Finnish Registry for Kidney Diseases during the study period. We performed survival analysis by generating a Kaplan–Meier survival plot until first event of end-stage renal disease. The right-censoring occurred only if the patient was alive without event occurrence at last follow-up in 31 December 2011.

3. Results

3.1. *All patients*

During the study period 41,179 adults in Finland were treated for burns at hospitals as in- or outpatients. The total number of follow-up years was 374,603, with a mean of 9.1 years per patient. Total treatment periods numbered 115,828. Of the patients, 48% had only one treatment period; one treatment period refers to one hospital admission, including the