

Early diagnosis of contrast media-induced nephropathy in intensive care

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Abstract — At the Research Department in hospital of Nova Gorica we are faced with new cathlab practice and problems connected with it. Together with other project partners we intend to investigate contrast media induced nephropathy by measuring the release of NGAL, which is considered to be a good biomarker for detecting reduced kidney function. Our first priority is extensive study of NGAL and develop special detecting lab-on-a chip that should be small and simple to use at every day hospital practice. Our second priority is to develop new and intensify pre-existing collaborations and exchange of knowledge between project partners.

Index Terms — Cathlab practice, biomarker, Neutrophil gelatinase-associated lipocalin (NGAL)

1 GENERAL HOSPITAL OF NOVA GORICA

General Hospital of Nova Gorica is the youngest general hospital in Slovenia, from the health care program is the medium size Slovenian hospital, which is characterized by rapid growth and large dynamic processes. From an entrepreneurial point of view, the hospital is a large company and one of the largest companies in Primorska region.

The hospital was founded in 1956. At the beginning it was located in old adapted buildings and had four main departments: internal medicine, surgery, paediatrics and gynaecology. In the year of 1965 the state began to build new hospital which was finished in 1985. The new 536-bed hospital has a surgery, internal medicine, gynaecology, paediatrics, ophthalmology, ENT, orthopaedic departments. It has a 750 employee, from which 82 specialists, 4 with PhD and 2 with BSc.

2 RESEARCH DEPARTMENT

The research department in Hospital Nova Gorica is located at the unit of intensive care and cardiology. The rapid medical technology development requires constant education and follow new developments. At our research department doctors and researchers are working together to investigate appearing medical questions and seeking for new knowledge and better solutions.

2.1 Research Areas

The intensive care unit and cardiology were engaged in various research fields, such as (i) arterial hypertension, (ii) autonomic nervous system activity, (iii) baroreflex sensitivity, (iv) diastolic dysfunction of the left ventricle, (v) and vascular elasticity (vi). The ICU and cardiology department has already established a strong collaboration with University of Nova Gorica and Physiology and Pathology Department at University of Trieste through various studies exploring human nervous system [1-6]. We are also connected with researchers of Faculty of Computing and Informatics Institute (FRI) at University of Ljubljana. The result of this collaboration is special device and software for analysis of changes in velocity of blood in the arteries, which are now used in the study of elastic arteries in hypertensive patients [7-15]. Furthermore, The ICU and cardiology department has also established collaboration with Texas Heart Institute. As mentioned above, establishing collaborations with different institutions to reach constant flow of knowledge and technology transfer has always been our priority. We intend to continue with building a network of our collaborations through Trans2care project.

2.2 Activities in Trans2care project

Catheterization laboratory practice and contrast media
Lately medical contrast technology continues to evolve dramatically. As scanning technology advances so does the requirements for contrast media. At the hospitals we are faced with fast development of various types of contrast media with different enhancement effect and also wide range of side effects. The most common types of contrast medium for enhancing x-ray based imaging methods are iodine and barium. Various sorts of iodinated contrast media exist, with variations occurring between the osmolality, viscosity, absolute iodine content and concentration of iodine in different media [16]. However, recent surveys are shown that High Concentration Contrast Media (HCCM) allows a greater maximum enhancement in a shorter period of time using the same volume of contrast medium [16]. While modern contrast media are generally safe to use [17] medical conditions can be caused by the administration of various contrast media. At the research department at Hospital of Nova Gorica we are focused on risk of contrast-medium induced nephropathy (CIN) in high risk patients, especially in patients with reduced kidney function. To diagnose the kidney failure the technology for diagnosis is required. For this reason we are interested in biomarkers for detecting early stages of CIN and supporting technology that should be small, simple, fast and with large data capacity.

2.3 NGAL as biomarker

The recent studies show that Neutrophil gelatinase-associated lipocalin or NGAL (also known as lipocalin 2, oncogene protein24p33 or uterocalin) is appropriate biomarker for acute kidney injury [19]. This is small, robust protein that belongs to the lipocalin family of the proteins. It is expressed by neutrophils and various epithelia, including the renal proximal tubules. Because of its small molecular size and resistance to degradation it is readily excreted and detected in the urine. While the functions of NGAL are not fully understood, it appears to be upregulated in cells under stress. However, NGAL levels rise significantly in both urine and blood as a response to kidney injury what makes it a useful marker of such injury [18]. The NGAL is mostly quantified by researchbased ELISA assays, which are impractical in the clinical setting. The development of small lab-on-a chip for simple and quick clinical measurement of plasma and urine NGAL would make it easier. It would also enable clinical investigators to assess the potential of this molecule as a diagnostic marker or a marker for response to use of contrast media.

3 HOSPITAL OF NOVA GORICA IN TRANS2CARE

Through Trans2care project we intend to study contrast induced release of NGAL. We will continue the collaboration with University of Nova Gorica to study the chemistry of NGAL and possibly develop specific lab-on-a-chip. We also see the possible connection with University in Trieste, where they can help us with specific studies of NGAL for instance reproducing in it vitro on endothelial cells, test NGAL on kidney cells (cytotoxicity assays). On the other hand we can offer other project partners data and knowledge of cardiovascular technology.

4 CONCLUSION

Through the initiated Trans2Care project we intend to contribute through the activities and studies aimed to a deeper understanding of NGAL function and developing detection technologies. That will help us at diagnostic of reduced kidney function and also at studies of contrast-media induced release of NGAL. On this way we can compare the safety of different types of contrast media. Our other goal is to connect with the research institutes, universities within the project partners to build the network of knowledge, innovation and technology transfer.

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