



Time for a full digital approach in nephropathology: a systematic review of current artificial intelligence applications and future directions

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Abstract

Introduction Artificial intelligence (AI) integration in nephropathology has been growing rapidly in recent years, facing several challenges including the wide range of histological techniques used, the low occurrence of certain diseases, and the need for data sharing. This narrative review retraces the history of AI in nephropathology and provides insights into potential future developments.

Methods Electronic searches in PubMed-MEDLINE and Embase were made to extract pertinent articles from the literature. Works about automated image analysis or the application of an AI algorithm on non-neoplastic kidney histological samples were included and analyzed to extract information such as publication year, AI task, and learning type. Prepublication servers and reviews were not included.

Results Seventy-six (76) original research articles were selected. Most of the studies were conducted in the United States in the last 7 years. To date, research has been mainly conducted on relatively easy tasks, like single-stain glomerular segmentation. However, there is a trend towards developing more complex tasks such as glomerular multi-stain classification.

Conclusion Deep learning has been used to identify patterns in complex histopathology data and looks promising for the comprehensive assessment of renal biopsy, through the use of multiple stains and virtual staining techniques. Hybrid and collaborative learning approaches have also been explored to utilize large amounts of unlabeled data. A diverse team of experts, including nephropathologists, computer scientists, and clinicians, is crucial for the development of AI systems for nephropathology. Collaborative efforts among multidisciplinary experts result in clinically relevant and effective AI tools.

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Techniques For Nephropathology

Scott C. Dulebohn



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Bancroft's Theory and Practice of Histological Techniques E-Book Kim S Suvarna, Christopher Layton, John D. Bancroft, 2012-10-01 This is a brand new edition of the leading reference work on histological techniques It is an essential and invaluable resource suited to all those involved with histological preparations and applications from the student to the highly experienced laboratory professional This is a one stop reference book that the trainee histotechnologist can purchase at the beginning of his career and which will remain valuable to him as he increasingly gains experience in daily practice Thoroughly revised and up dated edition of the standard reference work in histotechnology that successfully integrates both theory and practice Provides a single comprehensive resource on the tried and tested investigative techniques as well as coverage of the latest technical developments Over 30 international expert contributors all of whom are involved in teaching research and practice Provides authoritative guidance on principles and practice of fixation and staining Extensive use of summary tables charts and boxes Information is well set out and easy to retrieve Six useful appendices included SI units solution preparation specimen mounting solubility Provides practical information on measurements preparation solutions that are used in daily laboratory practice Color photomicrographs used extensively throughout Better replicates the actual appearance of the specimen under the microscope Brand new co editors New material on immunohistochemical and molecular diagnostic techniques Enables user to keep abreast of latest advances in the field *Theory and Practice of Histological Techniques* John D. Bancroft, 2008-01-01 This leading reference work on histological techniques is an essential and invaluable resource no matter what part you play in histological preparations and applications whether you re a student or a highly experienced laboratory professional **National Library of Medicine Current Catalog** National Library of Medicine (U.S.), 1982 **Current Catalog** National Library of Medicine (U.S.), 1982 First multi year cumulation covers six years 1965 70 **Journal of Pharmacological Methods** , 1987 **Techniques for Nephropathology** DAVID E.. DOWLING ALLEN (JOHN P.), John P Dowling, 2019-05-31 First Published in 1981 this book is an in depth exploration into the methods and techniques applied to the treatment of diseases in the kidney Carefully compiled and filled with a vast repertoire of notes diagrams and references this book serves as a useful reference for students of medicine and other practitioners in their respective fields *Histochemistry in Pathologic Diagnosis* Samuel S. Spicer, 1987 **Small Animal Laparoscopy and Thoracoscopy** Boel A. Fransson, Philipp D. Mayhew, 2021-12-20 The newly revised Second Edition of Small Animal Laparoscopy and Thoracoscopy is a rigorous update of the first book to provide comprehensive and current information about minimally invasive surgery in dogs and cats With a focus on techniques in rigid endoscopy the book also includes guidance on additional surgeries outside the abdomen and chest New chapters describe newly developed surgical techniques while existing chapters have been thoroughly updated The authors include detailed stepwise instructions for each procedure including clinical photographs Pre operative considerations patient positioning portal placement and

postoperative care are also discussed with key points of consideration outlined for each surgery Purchasers of the book will also receive access to a companion website featuring video clips of the fundamental skills and surgical techniques described in the resource The book also offers An introduction to laparoscopic suturing and knot tying with accompanying video tutorials A thorough introduction to the equipment used in laparoscopic and thoracoscopic veterinary surgeries including imaging equipment surgical instrumentation energy devices and stapling equipment Clear explanations of foundational techniques in laparoscopy including laparoscopic anesthesia access techniques contraindications complications and conversion Robust descriptions of fundamental techniques in thoracoscopy including patient positioning port placement contraindications complications and conversion Discussions of a wide variety of laparoscopic and thoracoscopic surgical procedures Small Animal Laparoscopy and Thoracoscopy is an essential reference for veterinary surgeons veterinary internal medicine specialists and residents and small animal general practitioners seeking a one stop reference for minimally invasive surgery in dogs and cats

Atlas of Medical Renal Pathology Stephen M. Bonsib,2014-07-08 The kidney is an organ with complex organogenesis susceptible to numerous misadventures in development and is exposed to a diverse array of insults of hematogenous and lower urinary tract origin This Atlas of Medical Renal Pathology provides an overview of the development macroscopic and microscopic features of the normal kidney This is followed by a comprehensive survey of developmental and cystic kidney diseases vascular diseases and tubulointerstitial diseases An emphasis is placed on gross diagnostic findings with detailed histological correlates In addition the histological immunofluorescent immunohistochemical and ultrastructural features of the major glomerular diseases and renal transplantation pathology are presented This compendium of non neoplastic kidney diseases illustrates the vast majority diseases you are likely to encounter in surgical and autopsy pathology

Renal Disease Jacob Churg,Jay Bernstein,Richard J. Glassock,1995 *Silva's Diagnostic Renal Pathology* Xin J. Zhou,Zhou,Zoltan G. Laszik,Tibor Nadasdy,Vivette D. D'Agati,2017-03-02 An algorithmic approach to interpreting renal pathology updated in light of recent advances in understanding and new classification schemes

Systemic Lupus Erythematosus George C. Tsokos,2020-04-07 This completely updated and expanded 2nd edition of Systemic Lupus Erythematosus A Manual includes topics not covered previously with contributors who are at the forefront of each specific topic and with a global appeal Each chapter is short and is presented critically with selected references which should be valuable to a wider audience This book combines basic with clinical science to help internists and specialists in the diagnosis and management of patients with SLE It is a quick referral for people in the pharmaceutical industry in their efforts to bring much needed drugs It provides all the needed information to basic researchers old and new alike who wish to enter the field of lupus and systemic autoimmunity in general Focused state of the art chapters prepared by top notch experts in the field Latest understanding of cellular molecular biochemical aspects of disease pathogenesis Advanced aspects of genetic microbiome environmental hormonal and immunological contribution to the expression of the disease Current understanding

of clinical features of the disease Recent efforts to develop new treatments Manual of Diagnostic Antibodies for Immunohistology Anthony Siew-Yin Leong,Kumarasen Cooper,F. Joel W-M. Leong,2003 The rapid acceptance of immunohistochemistry as an important and even indispensable adjunct to morphological examination and diagnosis requires the modern anatomical pathology laboratory to be conversant with and proficient in immunostaining procedures as well as methods of tissue processing and antigen retrieval and the underlying characteristics of the increasing number of antibodies and antisera available This fully revised expanded and updated edition provides a comprehensive list of antisera and monoclonal antibodies that have useful diagnostic applications in tissue sections and cell preparations Various clones which are commercially available to detect the same antigen are listed and the sensitivities and specificities of the antibodies are discussed Importantly the authors all pathologists with a wealth of experience in immunostaining procedures provide fully referenced details and expert advice on each reagent with the reader will find invaluable Finally the appendices provide easily accessible and clear summaries of selected antibody panels for specific diagnostic situations details of heat induced antigen epitope retrieval including the use of microwaves and a useful reference to the websites of the main antibody suppliers **Diseases of Aquatic Organisms** ,1990 **Diagnostic Ultrastructure of Non-neoplastic Diseases** John M. Papadimitriou,Douglas W. Henderson,Dominic V. Spagnolo,1992 A companion volume to the work Ultrastructural Appearances of Tumours this is a guide to the diagnosis of a variety of non neoplastic diseases encountered in diagnostic human ultrastructural pathology It is intended for use by ultrastructural pathologists *Leong's Manual of Diagnostic Antibodies for Immunohistology* Runjan Chetty,Kumarasen Cooper,Allen M. Gown,2016-11-28 A detailed A Z guide and an indispensable source for pathologists ensuring correct application of immunohistochemistry in daily practice Medical Image Understanding and Analysis María Valdés Hernández,Víctor González-Castro,2017-06-20 This book constitutes the refereed proceedings of the 21st Annual Conference on Medical Image Understanding and Analysis MIUA 2017 held in Edinburgh UK in July 2017 The 82 revised full papers presented were carefully reviewed and selected from 105 submissions The papers are organized in topical sections on retinal imaging ultrasound imaging cardiovascular imaging oncology imaging mammography image analysis image enhancement and alignment modeling and segmentation of preclinical body and histological imaging feature detection and classification The chapters Model Based Correction of Segmentation Errors in Digitised Histological Images and Unsupervised Superpixel Based Segmentation of Histopathological Images with Consensus Clustering are open access under a CC BY 4 0 license Subject Guide to Books in Print ,1984 Techniques for Nephropathology DE Allen (Ed),1981 *Innovations in Nephrology* Geraldo Bezerra da Silva Junior,Masaomi Nangaku,2022-10-28 Our world is facing unprecedented technological development which affects all the sectors of society The 4th industrial revolution has brought numerous advances that are currently integrated in our daily life including artificial intelligence A I internet of things IoT genetic engineering 3D printing and robotics The health care sector is one of the most

impacted by these technologies of the so called digital era From the simple advent of medical records to robotic surgery health care has significantly changed from the XX to XXI century and is constantly changing incorporating novel technologies Nephrology is itself an innovative branch of medicine created as a discipline in the 1960s with breakthrough inventions such as the dialysis machine which made it possible to prolong life of those who suffer from chronic kidney disease kidney transplant with point of care immunosuppression that favours maintenance of kidney allografts for long years kidney biopsy which made it possible to discover the mysteries of glomerulonephritis and nephropathology Novel technologies such as A I IoT robotics stem cells 3D printing mHealth eHealth and several others are starting to be applied in nephrology with promising results It is possible that a great part of these technologies will become routinely available in clinical practice and the burden of kidney diseases will significantly decrease once prevention prediction detection monitoring and treatment of kidney diseases are more precise with patients taking part in the process and becoming more and more connected This book gathers essential information on the technologies that have been applied in nephrology and that can be applied in the future with real possibilities of improving the care of kidney diseases At first glance this work is directed to the entire nephrology community and all the healthcare professionals that deal with kidney diseases Researchers from different fields not directly linked to nephrology may also be interested in the book since many of the topics presented are related to other areas and serve as examples of their uses in medicine such as artificial intelligence robotics and big data Finally the content provides an important resource to medical students discussing technologies that will certainly be integrated in their professional practice

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