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Case collections: a valuable teaching tool in Pathological Anatomy.

Colecciones de casos: una valiosa herramienta docente en Anatomía Patológica.

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Summary: The specialty of Pathological Anatomy (PA) is based on the histological study of tissue samples to obtain clinicopathological diagnoses. The review of the microscopy slides generated in the healthcare activity can be a tool of teaching interest. These "case collections", which we can define as "closed sets of cases selected for their teaching interest", allow the AP resident or student to become familiar with the histological characteristics of normal tissues, the different pathological entities and other histological findings. In this narrative review we describe the characteristics of these case collections, their typology, forms of use, advantages and disadvantages; Furthermore, we describe the impact of the digitization of Pathological Anatomy services on the preparation of case collections.

Keywords: medical education; active learning; case collections; teaching in Pathological Anatomy; teaching tools; clinical simulation; digital pathology.

Resumen: La especialidad de Anatomía Patológica (AP) se basa en el estudio histológico de muestras de tejidos para obtener diagnósticos clínico-patológicos. La revisión de las láminas de microscopía generadas en la actividad asistencial puede ser una herramienta de interés docente. Estas "colecciones de casos", que podemos definir como "conjuntos cerrados de casos seleccionados por su interés docente", permiten al residente o estudiante de AP familiarizarse con las características histológicas de los tejidos normales, de las distintas entidades patológicas y otros hallazgos histológicos. En esta revisión narrativa describimos las características de estas colecciones de casos, su tipología, formas de uso, ventajas e inconvenientes; además, describimos el impacto de la digitalización de los servicios de Anatomía Patológica en la elaboración de colecciones de casos.

Palabras clave: educación médica; aprendizaje activo; colecciones de caso; docencia en Anatomía Patológica; herramientas docentes; simulación clínica; patología digital.

1. Introduction

Pathological Anatomy is an eminently diagnostic medical care specialty whose activity takes place predominantly in the laboratory and focuses on precision diagnosis through the use of tissue samples from which histological images are generated that are analyzed by the specialist doctor. These tissues can be varied: surgical specimens, solid samples (biopsies) or liquid samples (exfoliative or aspiration cytology), fundamentally.

In the analytical stage (which encompasses the processes that range from the moment the sample is received and recorded in the AP laboratory, until a histopathological report is issued), blocks of tissue in paraffin and slides for microscopy are generated that, once the report, will be stored for an extended period of years. This, helped by the traceability

of samples and integration into databases, allows the collection and review of interesting cases and their use as a learning tool.

Case collections, defined as a set of pathological study cases selected for having some particular interest, have traditionally been used as a learning tool in the context of PC residency (1), although there have not been major discussions about the formal limits of its characteristics as a pedagogical tool.

In recent decades, the digitization of microscopy slides has made it possible to view histological images on monitors and, in this way, solve some problems associated with traditional physical support, such as loss of material, degradation of coloration, theft, physical transfer to other centers for second opinions, etc. (1).

2. Methods

Qualitative narrative review study that includes the definition and history of case collections, the way they are prepared, their different formats, pedagogical foundation, possible uses and their future possibilities with the intention of systematizing a common practice of health services. Pathological Anatomy. Qualitative information is also collected about the reflections and perceptions of the authors.

3. Results and Discussion

Defining case collections and brief history of case collections.

Since the beginning of the histological study of human tissues with light microscopy, the preservation of cases for study and learning has been used informally for transmission from teacher to student. With the development of the specialty of Pathological Anatomy as a healthcare discipline, collections and the review of archival cases have continued to be used as learning tools within clinical-teaching institutions. These collections traditionally consist of histological slides of cases selected by specific themes or organs; organized in properly labeled boxes.

In fact, not only have collections of histological preparations existed over the past centuries; Collections of surgical pieces have also been created that we can still see today preserved in formaldehyde in the rooms of some medical schools or museums associated with them. This is reflected, for example, in the museums of the Surgeon's Hall in Edinburgh or the museum of the Royal College of Medicine in London, to name just a few. Another institution, the Anatomopathological Institute of Erlangen, recently carried out an initiative to restore and digitize the collection of macroscopic slides belonging to that service (2). In Spain, interest in conserving and recovering this type of collections by some institutions has also been documented (3).

In 2007, the renowned pathologist Juan Rosai created, in collaboration with the Academy of Pathology of the United States and Canada (USCAP), the Rosai Collection (4). This initiative was developed with the intention of compiling cases that are already part of the history of PA and gave rise to a collection composed of more than 20,000 cases accompanied by clinical notes. This collection, in addition to being a historical testimony of the specialty and reporting on discussions about cases, is an educational tool that makes available to any pathologist or interested person a series of cases to which, in other times, they could only have access the people of the institution to which they belong.

Below are some examples of online digital collections that universities and other entities have made available on the Internet, in digital and open access format, to share and disseminate knowledge and that may be useful to residents and teachers in AP:

- **Free pathology** . It is a website that displays a Wiki-type format and that allows you to study microscopy cases with a very didactic approach, since it allows you to simulate the request for laboratory techniques using drop-down menus (5. https://librepathology.org/)

- **Laboratory Medicine and Pathology** , University of Toronto. This institution offers a free access website (6. https://dlm.lmp.utoronto.ca/public-lists/pathology-slides #) with digitized microscopy images accompanied by clinical information. They are accompanied by useful taxonomic labeling to facilitate navigation according to the topics of interest.

- **Virtual Pathology** at the University of Leeds. They have a website (7. https://www.virtualpathology.leeds.ac.uk/) that houses a collection of 10,464 cases. The website has a search engine that allows cases to be filtered according to different parameters (type of sample, biopsy organ, type of pathology, etc.).

- **Webpathology** . It is an open access website (8. https://www.webpathology.com/index.asp) that, since 2003, has collected collections of macroscopy and microscopy photographs. As of today, the collection includes 13,153 photographs (as of the date this article was written) separated by categories according to the system to which they belong and also by pathologies. The photographs are accompanied by anonymized clinical information about the patient.

How case collections are prepared.

The rudimentary form of case collections is the retrieval of archival cases to study rare entities or cases of great pedagogical interest according to the needs of the resident or the instructions of the attending physician, the resident's tutor or in charge of his or her training at that time. The collection would be the structured and relatively stable form of this activity that allows certain teaching objectives to be satisfied. This conceptual framework developed in the context of Pathological Anatomy for care and research can also be applied to other educational areas, such as: the teaching of Pathological Anatomy in the various Undergraduate degrees (Medicine, Dentistry, Veterinary Medicine) and in postgraduate training, as well as in training centers for Pathological Anatomy Technicians. We can categorize case collections based on several parameters:

- *According to the agent who created the collection* . It may be the tutor, assistant doctor, head of service/teaching or a qualified specialist pathologist, or it may be the resident who does it, with or without supervision of the assistant.
- *According to the user of the collection* . It may be a student of a Bachelor's degree that teaches the subject of Pathological Anatomy (Medicine, Dentistry, Veterinary Medicine), a student of the Professional Training of Pathological Anatomy and Cytology Technician or, more frequently, a resident doctor specializing in Anatomy. Pathological. In this article we use the term "AP student" to refer to any of these groups that make use of the Pathological Anatomy case collections.
- *According to the temporal sequence* . The collection of cases can be built retrospectively, selecting in advance entities that the student or resident should know or it can be done prospectively, collecting over a more or less prolonged period of time the cases of interest that will arise in practice. daily clinic and incorporating them into the collection.

- *Depending on the support or format of the collection* . Traditionally, collections have been produced in physical format, with the slides stored on a physical storage device and a list with a case identifier and the final diagnostic judgment of the case or a description of its relevant findings. Currently, Pathological Anatomy services are adopting a progressive digitalization of histological preparations and their work cycles, with the growing possibility of scanning slides and viewing histological images in digital format and creating digital collections.
- *According to the owner or scope of use* . Initially, case collections are created in a Pathological Anatomy service of a hospital and are for internal use for residents who train at that hospital or training staff who carry out training stays at that institution. Subsequently, with the widespread use of the Internet, some collections of cases that were private at the time were opened to the public and are now in the public domain thanks to their digitization and free access. In these cases, it is essential to anonymize the patient's data or other data that could identify the case (name of the hospital center, biopsy number, etc.).

Pedagogical foundations of case collections.

- Case-based learning. The study of collections of cases allows us to confront real diagnostic situations, not fictitious and not purely theoretical. It is an active educational method in which the resident must use complex cognitive skills, making use of critical thinking and, sometimes even integrating clinical information along with image recognition, to reach the resolution of the problem (9).
- Clinical simulation. The observation of clinical cases under the microscope is an active pedagogical approach that fairly faithfully replicates what is the work that a pathologist must perform in the microscopic study phase. However, and as is intrinsic to pedagogical simulation, the study of case collections does not cover all the complexity of clinical practice (10).
- Vicarious learning or Bandura's social learning theory (11). It postulates that learning is carried out through observation: the resident observes and retains how the tutor diagnoses the cases and interprets them. It is a passive but necessary learning method to have a reference to verify or reject the interpretations that the resident makes of the biopsy.
- Pattern recognition. Becoming familiar with a series of cases that have certain characteristics (such as: cases with canonical characteristics, multiple cases with subtle differences between them, cases that pose limitations in diagnosis, cases that pose subjective interpretations, etc.) allows the resident to acquire training, previous experience and reference images with which to compare when faced with other cases. It is similar to inducing "supervised learning" in the resident, making an analogy with Artificial Intelligence systems that perform pattern recognition tasks (12).

Pedagogical proposals for the use of case collections.

- Flipped-classroom. It is a teaching methodology that translates into Spanish as "flipped class" and in which it is the student who must familiarize himself individually and outside the classroom with the theoretical content so that, later, he can be the teacher who facilitates learning. of these contents in the context of the classroom using various resources (corrections, clarifications, explanations, didactic exercises, problem solving) (13). Compared to traditional teaching methods, in which the teacher taught the theoretical content for the first time in a master class, the "flipped-classroom" owes its name to the fact that it is the student himself who establishes first contact with the body of students. knowledge and the teacher

intervenes in later phases of the process with the aim, usually, of exercising a more dynamic educational role than with traditional methods, in which, generally, the student adopts a more passive role. In the "flipped-classroom" method applied to the study of case collections in the Pathology Residency, residents take the boxes and examine the cases independently, without supervision of their tutor, individually or in groups with others. residents or students. Subsequently, in a session with their tutor, they discuss the findings, make a description of the histological findings of the preparation and present their diagnostic proposals or propose additional techniques that they would request to reach the differential diagnosis. Finally, the tutor evaluates the resident's performance according to established criteria or uses the cases as an introduction to a more extensive or exhaustive explanation. As a teaching proposal: the adjunct leaves a collection of cases for the residents to examine over a period of time (example: 2 weeks). After that time, the teacher summons them to a place and time frame so that in a specific period of time (1-2 hours, depending on the size of the collection), they can see the cases together on the multihead microscope or on a screen. computer. In turns, each of the residents comments on the microscopic findings of the case and, afterward, the tutor reveals the final diagnosis and enriches the discussion. Finally, the resident can review the case to restate the explanation.

- Prospective construction of cases. In the case of specialized training in PC, the resident can be an active element in the selection and compilation of cases, following the theoretical program of the specialty. This can be done during the course of their rotations, and the resident can create their own collection of cases that have served them during their learning, simulating the concept of a "portfolio" or even forming a constituent part of it. You can also do so by expressly searching for cases that may be of interest to cover areas of learning in which you perceive weakness or cases of surgical specimens that have a low relative weight compared to the set of routine pathology (example: endomyocardial biopsy, biopsy muscle, etc.). Subsequently, the resident can present these cases, taking the initiative to present and explain them ("learning by teaching").
- Preparation of evaluation exercises. Case collections can be used for evaluative purposes in the context of Pathology residency or even in the context of a final specialty exam. We can separate these types of evaluation according to their purposes:
    - Formative evaluation. The objective of this type of evaluation is to serve for learning, promoting interaction with the tutor and feedback, without the result being linked to an evaluation that conditions their progress in the specialty or counts in official bulletins or in the validation of their training.
    - Summative evaluation. It aims to determine the achievements or degree of compliance with the training program at the end of the school period. This evaluation can be both internal (within the teaching service) and external (at the national level). This is the case of what happens in some European countries, such as Portugal (with its "Prova Nacional de Avaliação e Seriação"/"National Evaluation and Classification Test") or Germany ("Prüfung zum Facharzt für Pathologie"/"Examen of Specialist in Pathological Anatomy"), in which there is an end-of-residency exam in which one of the evaluable competencies is the study of microscopy cases.
    - Diagnostic evaluation. The objective is to know the level of the resident's microscopy knowledge base at a given time. It can be done at the beginning of the residency, in the middle of the training period or at the beginning of each school year or rotation to check the resident's base level and measure their quantitative progress over a period of time (something like the "learning speed").).

Advantages for the AP student:

- Generates a controlled "simulation" environment. Help the student in the first phase of learning to create a criterion of self-confidence outside of clinical practice and without the consequences of a wrong diagnosis.
- Train other specialists who stay in the Pathological Anatomy service (example: dermatologists, nephrologists). For these professionals it is not so necessary to learn the laboratory routine and the collections allow them to see a wide variety of entities without the need for them to arrive at the service during their rotation period (usually 1-2 months long). Furthermore, their learning would be outside the care work circuits, so that the risk of losing materials is minimized and favors the resident's autonomy in their learning.
- They facilitate distance learning. Digitized collections provide the opportunity for distance learning in certain cases in which the student cannot be physically present at the service (medical or maternity leave). They also allow learning from other people who cannot physically be in the service, but have a legitimate interest in seeing the preparations of the collection (example: online communities).
- Eliminates the need for multihead or other microscopes for learning (14). This allows a greater number of students to benefit from the same computer screen or projected images in a classroom, avoiding the availability of optical microscopes to view the slides, which can be a limiting factor in some cases and/or security services. Pathological Anatomy.
- Possibility of developing courses and other regulated training with case collections. The intrinsic characteristics of this specialty make it possible to collect biopsies for the development of courses with stable and lasting content, which is more difficult to do in other specialties that require other types of skills (for example: interaction with the patient, development of patient attitudes. active listening, development of motor skills, etc.).

Advantages for teachers:

- Create a minimum corpus of mandatory knowledge. Possibility of standardizing the cases that the student sees and ensuring that they see certain entities that may not appear in clinical practice during their training periods.
- Facilitates the implementation of evaluations. Whether these are summative or formative, official or informal, so necessary in a context like the Spanish one, in which there are no exit exams at the end of specialized training. Having a large collection that serves as a reserve fund allows microscopy case examinations to be carried out quickly and with minimal interference with healthcare activity.
- Learning planning. In daily practice, it is not always possible to find the right case at all times. The compilation of cases of interest makes it possible to easily have two cases that may present problems in the differential diagnosis or entities that may be confused and establish comparisons to establish the interpretation in the student ("diagnostic pitfalls").
- It enables the recording of rare or very infrequent cases to make them known to students and make them deepen their knowledge beyond the entities that are usually seen on a routine basis.

Advantages for the organization of teaching services:

- Offers alternatives to traditional teaching. It contributes to organizing and structuring teaching in those situations of high care pressure in which the associate pathologist finds it difficult to dedicate teaching time to the resident and allows a quick response to teaching needs in those other situations in which the tutor is not

present. available (meetings, sick leave, other commitments). However, case collections should be understood as a complement or synergy of other teaching methods and not as a replacement for them.

- Optimization of time dedicated to teaching. In the case of specialized training, it allows optimizing the teaching time with the resident, ensuring that in a period of little time dedicated to the resident, maximum returns can be obtained in terms of teaching use and that teaching does not represent a detriment to the quality of care or other work commitments in the service.
- Low marginal monetary cost. Physical collections do not require material resources that are not already available to the service and that have not already been used in the normal work cycle of the service, in most situations. In the case of digital collections, although the implementation of a Digital Pathology work cycle is expensive due to the initial investment in machinery (scanner, software, etc.), the preparation of digital case collections for teaching purposes does not have why assume an increase in the marginal cost in monetary terms of this investment.

Advantages for society as a whole:

- Quality in training. It helps ensure that the objectives of the teaching programs are met, which results in higher quality standards in the training of all students.
- Equity in training. It helps to ensure that residents of small hospitals or smaller cases can be trained in certain areas of competence that are concentrated in reference hospitals, eliminating inequalities and facilitating the comparability of evaluations (14).

Disadvantages

- It is a simulacrum of reality, not reality. The use of collections lacks the realism component of dealing with cases that are still active, with patients who do not yet have a diagnosis, and with the characteristics and pressures of clinical care. For example, in the case of Pathology residents, they could lose the perspective of urgency required by some cases that require immediate therapeutic action (examples: calciphylaxis, chance discovery of malignancy, etc.) and the delivery times considered reasonable for each type of sample.
- The management competence of biological material is not exercised. This includes the quality control of the preparations, the relevance of performing new techniques (new sections, immunohistochemistry, etc.) on very quantitatively limited samples and knowing how to convey to the requesting doctor the suitability of the sample and its limitations in order to issue a diagnosis. precisely.
- Loss of material for different reasons. In the case of collections of cases in physical format, the biggest problem is the misplacement, loss, theft or deterioration of the preparations.
- Digital storage. Digitized microscopy case files usually require a large storage capacity on electronic devices, with an associated high economic cost, and this can be problematic, as noted in the article by Loeffler (15). Additionally, electronic and connectivity problems may arise.
- Chronophagous task. It can be costly in terms of time, especially when done retrospectively. However, time can be a long-term investment, since case collections are created once and can be used for decades with minimal subsequent modifications.

Future prospects

The digitization of services consists of the systematic integration into the service's work cycles of optical microscopy histological preparations converted into digital images.

Making digital collections of cases will be increasingly simpler, the search for cases will be simpler, facilitating the incorporation of cases to the collection, thus eliminating the inconvenience of deterioration of the biological sample and the need to go to a physical archive .

Furthermore, this digitalization allows cases to be shared globally, contributing to the universalization of knowledge and raising the quality standards of education in Pathological Anatomy regardless of the location or material resources of the hospital in which the resident is trained. It can also help create "flexible collections" or with taxonomic organization. That is, the digitization of collections can allow us to select with filters the cases that interest us within a large collection. For example, a gastrointestinal stromal tumor could be found using the "digestive pathology" or "gastric pathology" filter, but also using the "mesenchymal tumors" filter. These taxonomies have already been implemented, as reflected in a study (15), and seem to improve some of the problems associated with the creation of digital collections.

That said, digitalization must overcome some hurdles before its full potential benefits can be extracted. It is a process that requires the acquisition of infrastructure and know-how on the part of the services that can be expensive and take time. Other problems that need to be addressed are the question of the cost of digitization in economic and time terms, the storage of files, the organization and classification of cases of educational value.

5. Conclusions

- The intrinsic characteristics of the Pathological Anatomy specialty allow for the creation of files of histological images of real clinical cases with teaching interest that, organized according to pre-established criteria in case collections, can be used by residents as a teaching tool.
- Case collections are an excellent teaching method with a long tradition that has multiple advantages and makes it possible to fill training gaps in the specialty of Pathological Anatomy. Its use does not have to be limited to the environment of a hospital service and can be used in many other contexts, in part, thanks to the digitization of microscopy images.
- Pedagogically, case collections find their foundation in clinical simulation and clinical case-based learning. Its teaching strength lies in its efficiency, low economic cost and its potential to correct training inequalities between residents of centers with different characteristics, as well as evaluations of various kinds.

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