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Literature review: Preventive actions on contrast media extravasion in patients

[Revisión literaria: Acciones preventivas sobre extravasación por medio de contraste en pacientes]

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Resumen

Objetivo: Analizar evidencias científicas sobre las medidas de prevención relacionados a extravasación con medios de contraste en pacientes. Metodología: Se realizo una revisión literaria utilizando 4 bases de datos SciELO, Pubmed, Scopus y Google académico en los últimos diez años, se incluyeron estudios en idiomas inglés, español y portugués publicados revistas indexadas de texto completo, llevando un análisis crítico de cada artículo seleccionado, reflejando una matriz para ordenar y categorizar. Resultados: de los 15 artículos científicos de los resultados encontrados muestran la necesidad de proveer la identificación de la escala de riesgo (bajo. leve moderado y alto) Las áreas afectadas suelen presentar lesiones benignas caracterizadas por hipervolemia y eritema localizado que tienden a curar espontáneamente sin secuelas. Sin embargo, también pueden producirse lesiones graves, como el síndrome compartimental. Por estos motivos, es necesario conocer a los pacientes en riesgo, características técnicas, diagnóstico precoz y manejo oportuno de esta complicación. Estas son las habilidades básicas que todo profesional de enfermería especialista debe poseer. Conclusiones: La extravasación considerada un indicador de la calidad de servicio de atención en el cuidado de enfermería, con los cuales se debe tomar las medidas preventivas, correctivas y educativas en el área donde se manipule los accesos venosos, una adecuada elección de sitio de inyección, puncionando venas gruesas a partir del pliegue del codo hacia proximal evitando futuras complicaciones para disminuir la incidencia como objetivo cero.

Palabras clave: Acciones preventivas, extravasación, medios de contraste, paciente.

Abstract

Objective: To analyze scientific evidence on prevention measures related to contrast media extravasation in patients. Methodology: A literature review was conducted using 4 databases SciELO, Pubmed, Scopus and Google Scholar in the last ten years, including studies in English, Spanish and Portuguese published in full text indexed journals, carrying a critical analysis of each selected article, reflecting a matrix to sort and categorize. Results: of the 15 scientific articles of the results found show the need to provide the identification of the risk scale (low. mild moderate and high) The affected areas usually present benign lesions characterized by hypervolemia and localized erythema that tend to heal spontaneously without sequelae. However, severe lesions, such as compartment syndrome, can also occur. For these reasons, it is necessary to know the patients at risk, technical characteristics, early diagnosis and timely management of this complication. These are the basic skills that every specialist nursing professional should possess. Conclusions: Extravasation considered an indicator of quality-of-care service in nursing care, with which preventive, corrective and educational measures should be taken in the area where venous accesses are manipulated, an adequate choice of injection site, puncturing thick veins from the

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elbow crease towards proximal avoiding future complications to reduce the incidence as a zero objective.

Keywords: Preventive actions, extravasation, contrast media, patient.

1. Introduction

Accidental leakage (extravasation) of intravenous contrast medium (ICM) from the vascular space into adjacent soft tissues is one of the most common complications of injectable computed tomography (polymorphism); therefore, it is essential to identify risk factors related to extravasation in order to take preventive measures. The reported incidence of intravenous (IV) contrast media extravasation related to mechanical injection for CT has ranged from 0.1% to 1.2% [1-2] (1 / 1,000 patients to 1/83 patients). Extravasation can occur during hand or power injection. Extravasation can occur at both low and high flow rates (Garrigues et al., 2019). Extravasation occurring with dynamic bolus CT may involve large volumes of contrast medium (Varerla et al., 2015). Contrast injection rates have not been significantly associated with the frequency of extravasation; however, extravasations are more common when injections are performed in more peripherally placed catheters (Márquez et al., 2021).

Initial signs and symptoms, although most patients complain of initial swelling or tightness, and/or stabbing or burning pain at the site of extravasation, some experience little or no discomfort. On physical examination, the site of extravasation may be edematous, erythematous and painful (Varerla et al., 2015). Sequelae of extravasations Extravasated iodinated contrast media can cause injury to surrounding tissues, particularly in extravasated iodinated contrast media can cause injury to surrounding tissues, particularly in the skin, the production of an acute local inflammatory response may not peak for 24 to 48 hours (Rodríguez et al., 2008). Acute tissue injury resulting from extravasation of iodinated contrast media is likely, at least in part, related to their hyperosmolarity (Toril et al., 2017; Alfaro-Rubio et al., 2006). Despite this, the vast majority of patients in whom extravasations occur recover without sequelae (Varerla et al., 2015; Ocantos et al., 2009).

Contrast media are drugs with density similar to bone structures and metals, which attenuate radiographic images because they absorb ionizing radiation and allow the differentiated comparison of organs, according to their density. They are useful for the diagnostic process because they allow the generation of bioimages, due to the fact that their physicochemical characteristics produce differential signals in an anatomical and functional environment. Contrast media differ in their properties such as osmolarity, viscosity and ionic strength, factors involved in the generation of adverse reactions (Siccha et al., 2020).

To request diagnostic imaging, the patient should be classified on the following scale. Mild risk: This is the patient who has no pathological history or concomitant disease and therefore does not require nephroprotective pre-medication. Low risk: When there are doubts about the patient's pathological history, and nephroprotective pre-medication is optional. Moderate risk: This occurs when the patient has a history of atopy or previous adverse reaction and must be pre-medicated with nephroprotective agents. High risk: This risk is presented by multiple causes, such as adverse reaction, previous disease or age (Garrigues et al., 2019).

This type of patient requires an alternative non-contrast study to be performed, or in case the use of contrast medium is necessary, it must be chosen with criteria, and an adequate preparation for the study must be performed. Identification of high-risk patients Any patient presenting at least one of the following criteria should be considered at high risk Age over 75 years, creatinine greater than 1.5 mg/dl, congestive heart failure, diabetes, hypertension, collagenosis, myeloma, polycythemia, dehydration or the need for administration of more than 100mL of hyperosmolar

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contrast medium. In these patients, the criterion of the lowest possible risk to their health should prevail, with the rigorous application of the protocol for the application of contrast media and nephroprotection. The criterion of creatinine level measurement to identify patients with renal failure has recently been displaced by the measurement of the glomerular filtration rate (GFR), which yields more accurate results because it takes into account the patient's weight, age, sex and race. With this test it has been possible to detect 50% more patients at risk, compared to the measurement of creatinine levels, increasing the level of protection for patients at risk (Siccha et al., 2020; Toril et al.,2017).

The nursing professional applies the knowledge acquired academically for peripheral cannulation and transforms it into competencies that are evidenced in daily practices, it is necessary a first approach, direct contact through the use of senses and psychomotor behavior, that is, to perform the procedure; there can be no practice of this or that knowledge if experience is not obtained before (Sanchez et al.,2019). This is evaluated objectively through the observation of the care that the nurse provides to the subject of care in order to achieve the proposed objectives. The purpose of the literature review study is to deepen aspects related to preventive measures related to contrast media extravasation, which will be useful to apply preventive actions during nursing care in the radiodiagnostic service.

2. Materials and methods

The literature review was descriptive and four databases were consulted: SciELO, Pubmed, Scopus and Google Scholar, and 20 articles were found and 15 scientific articles were selected according to the thematic of preventive actions on contrast extravasation in patients. Likewise, the inclusion criteria were used: from 2010 to 2021, English, Spanish and Portuguese languages; indexed articles were excluded; researches that were found repeated in the databases and that presented only abstracts, texts that were not related to the topic and with publication dates prior to 2010 were excluded. Gray literature was also excluded, with the exception of doctoral theses, records excluded because they did not have open access or full text in PDF.
For a visualization in both databases, see details:

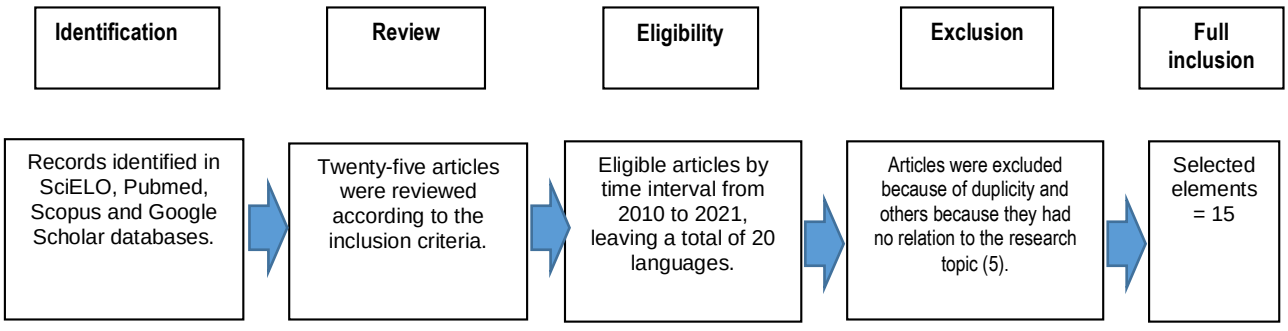

Figure 1. Prism diagram

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3. Results

A total of 160 articles were obtained, of which the summary of the studies was read, selecting 131 for complete reading, 29 of which could not be accessed. Subsequently, the inclusion and exclusion criteria were applied, leaving a total of 20 articles that were used for the technical review. The results were grouped individually, taking into account the position of each author. The incidence of extravasations varies from 0.1% to 3.6% according to international literature.

Table 1. Articles analyzed for the technical review

Author	Title	Year	Method	Results
García-Sánchez., Santa Cruz-Leonard, & Chongo-Solis (2019).	Prevención y tratamiento de la extravasación de quimioterapia endovenosa	2019	Systematic review	Knowledge of the prevention and treatment that nursing professionals consider during an intravenous chemotherapy infusion allows for feedback into the processes you specify, which can also introduce potentially significant changes in the attitudes and behaviors of the health care team. The importance of this information is based on verifying that the prevention and treatment of current intravenous chemotherapy extravasation can influence the overall behavior of health care team members because it can be systematized in clinical practice.
Toril & Rodríguez (2017).	Revisión sistemática de las complicaciones de los dispositivos de administración de tratamiento al paciente oncológico.	2017	Systematic review	Most complications can be avoided due to device implant failure or improper care, although it is difficult to determine which device will provide the best quality of life for the patient, as both are highly recommended. However, patients often refer to Porth Cart for its aesthetic results. The most common complications with endovenous devices are infection, thrombosis, mechanical complications, obstruction, dislodgement or catheter breakage.
Garrigues., Sánchez, García. (2019).	Guía de Manejo en la Extravasación de Medicamentos No Citostáticos.	2019	Guide	For the approach to non-inhibitory drug extravasation, the guidelines are based on general procedures such as: stop the infusion, aspiration of the infused drug from 5 to 10 cm, elevation of the extravasated extremity, administration of antidote according to the drug administered, drying with heat or dry cold, monitoring of lesions and exposure of photos.
Albert-Marí, et al., (2021).	Prevención y Tratamiento de Extravasaciones de Fármacos Antineoplásicos.	2020	Article	The prevention of drug leakage is regulated by individual and procedural factors; and the management of extravasation: physical and pharmacological measures.
Pacheco, Gago, Méndez (2014)	Extravasación de medios de contraste intravenosos en el sitio de la punción: Protocolo de actuación	2014	Protocol (Catalogue)	The frequency of contrast extravasation increased at the venous puncture site with the widespread use of motorized syringes. Most leaks cause only mild edema and redness. However, in some cases, they can cause severe skin damage and lead to compartment syndrome. Extravasation injuries usually resolve spontaneously and are treated conservatively. Although the complications of extravasation are well known, working and treatment criteria, based on literature or personal preference, are often subject to change, without an institutional working protocol.
Gómez, (2018).	Manejo de la extravasación de citostáticos: una mirada desde enfermería	2018	Article	. A comprehensive analysis of the science of producing nursing care for people with cytostatic extravasation concluded that, prior to the application of cytostatics, the main risk factor was the lack of knowledge of care staff about the treatment of oncology patients with intravenous chemotherapy, so there is a strong focus on preventing extravasation, starting with knowing which staff can detect and make decisions to minimize potential harm, thus providing safe, high-quality care to patients.
Vitolo, (2010).	Lesiones por extravasación	2010	Article	Extravasation injuries are rapid and appropriate responses to suspected release of biologically active substances from extravasation. The British National Health Service has developed an anonymous reporting system for extravasation and time of exposure and location where it occurred o In some cases, the. and it is concluded that in some cases infusion or automatic injectors cause damage for months and, if left in place for too long, lead to plastic surgery and, in rare cases, amputation.

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Galera, Sepúlveda, Sánchez, (2016).	Extravasación de medios de contraste intravenoso	2016	Review	Contrast iodine is a radioactive plaque-forming agent used in radiological examinations to enhance visualization of anatomical structures. Extravasation of contrast medium is defined as the accidental leakage of a variable volume of these solutions from the vascular space into adjacent tissues.
Torres-Muñoz, Marín-Navarro, & Gallego-Sánchez, (2018).	Cuidados De Enfermería En Los Accesos Vasculares – Guía De Recomendaciones	2018	Guide	This guide was designed due to the need for diagnostic tests, intravenous administration, fluid therapy, parenteral nutrition, blood products and hemodynamic monitoring. With the increase in hospital stay, and the complexity and characteristics of the patient requiring multiple venous cannulations, it is evident that the use of vascular devices does not prevent complications, such as phlebitis, thrombophlebitis, infiltration, extravasation, pneumothorax, hemothorax, infection. In recent years, strategies have been developed to reduce the economic impact, improve user satisfaction and reduce the number and severity of complications.
Rodríguez, (2020).	Extravasación de sustancias hiperosmolares en paciente pediátrico según el método de infusión.	2019-2020	Study	The use of hyperosmolar agents in neonates can be a risky practice due to the consequences of extravasation of these substances. In an effort to minimize harm, we studied the advantages and disadvantages of the main modes: direct transfer (bolus) and continuous/intermittent transfer; in conclusion, by analyzing 15 selected studies, treatments should be selected taking into account the advantages and disadvantages of each patient.
Santos, Nunes, Silva, Kusahara, Rodrigues, & Avelar, (2021).	Elaboración y validación de un algoritmo para el tratamiento de la infiltración y extravasación periférica en niños	2021	Article	Infiltration is characterized by leakage of a non-vesicant, non-irritant or irritant solution from the intravascular space to the outside of the vessel (2,5), whereas vesicant fluids cause extravasation. Research shows that improvement is more common in children receiving medications such as 10% glucose, ampicillin/sulbactam, vancomycin, high concentrations of electrolytes and phenytoin (6). And what is acyclovir, an antibiotic, Noradrenaline, dopamine, sodium bicarbonate, sodium chloride, calcium gluconate, Propofol, contrast media, blood and total parenteral nutrition (7) cause more extravasations.
Cifuentes & Aguirre (2014).	Pautas para aplicación controlada en medios de contraste endovasculares	2014	Article	A review of the current literature on the appropriate management of contrast agents used in radiology, computed tomography and magnetic resonance imaging, guidelines for intravenous administration and prevention of adverse reactions is underway. Patient risk classification programs and nephroprotection protocols to protect patient health.
Garrido, Rivera, Pesenti, Riquelme & Huete, Álvaro, (2020).	Medios de contraste intravascular en tomografía computada y resonancia magnética lo que el clínico necesita saber	2020	Article	Although radiology contrast media have an excellent safety profile, their use is not without risk and should be based on appropriate criteria after careful clinical evaluation, weighing the risks and benefits for each patient. Liaison between the attending physician, nephrologist and radiologist is required for evaluation of complex cases or special considerations when intravascular contrast is indicated.
Bonilla-Marciales, Chávez-Cañas, Hernández-Mogollón & Ramón-Jaimes, (2019).	Estrategias de prevención y control de las infecciones en pacientes oncológicos	2019	Article	Cancer is one of the world's most serious public health problems. Despite treatments and technological advances, a large number of infections still occur in cancer patients. Nursing care plays a key role in preventing the risks of infection associated with the different treatments used. The control of Healthcare Associated Infections (HAI) is indispensable, since it is considered the persistent care work of the nurse.
Varerla, Sepúlveda, Prieto & Pavanati, (2015).	Extravasación de medios de contraste intravenosos: Lo que todo radiólogo debe saber.	2015	Article	Accidental leakage of intravenous contrast medium (ICM) from the vascular space into adjacent soft tissues is one of the most common complications of multifocal computed tomography (MCT) procedures. The incidence is low and occurs in 0.1 to 0.9% of patients undergoing these studies. The affected areas often present as benign lesions characterized by hypervolemia and localized erythema that tend to heal spontaneously without sequelae. However, serious lesions, such as compartment syndrome, can also occur. For these reasons, it is necessary to know the patients at risk, preventive measures, technical characteristics, early diagnosis and

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				timely management of this complication. These are the basic skills that every radiologist should possess.
Varela, Prieto, Castro (w.d.).	Extravasacion de Medios de Contraste Intravenosos. Lo que todo radiologo debe de saber.		Guide	To reduce the incidence of this complication in ambulatory patients, some basic measures should be considered. One of the most important is to make an adequate choice of the injection site, puncturing thick veins from the elbow crease proximally. In the last decade, two technological advances have been developed that decrease the probability of extravasation occurring. One of these is multifenestrating venous lines, which not only have an outflow orifice at the distal end of the catheter, but also multiple lateral orifices. Lateral fenestrations act by slowing the flow velocity of the ICM, thus reducing hemodynamic stress on the venous walls. Another advance is the development and use of automatic extravasation detection devices such as tetrapolar patches that are placed at the injection site and measure local impedance. In the event of impedance changes caused by extravasation, they automatically stop the injector.
García-Sánchez, Santa Cruz-Leonard, & Chongo-Solis, (2019).	Prevención y Tratamiento de la extravasación de Quimioterapia Intravenosa.	2019	Article.	Knowledge of the prevention and treatment to be taken into consideration by nursing professionals in the extravasation of intravenous chemotherapy provides feedback about the processes that determine it, allowing, in addition, to introduce planned changes in the attitudes and behaviors of the nursing teams.

4. Discussion

The findings found in the literature review is relevant that peripheral catheterization is the most common procedure in nursing practice and extravasation is one of the most serious complications of this procedure as reflected in the guidelines reviewed, the incidence is 0.04% to 1.2% but Alfaro establishes an increase in oncology patients of the incidence to 6.5% due to factors related to treatment, age and disease so that nurses should consider this criterion to recognize and assess the risk factors to prevent the occurrence or avoid complications.

Siccha, et al., (2020), the risk factors are interconnected, which increase the likelihood of extravasation. They can be divided into four categories: corresponding to the patient, the venous device, the contrast media drug and the competent professional. The nurse who is responsible for the administration of contrast agents must take into account the type of drug to be administered, type of device and materials for catheter insertion, the nurse must be continuously trained to consider aspects related to the various factors that predispose to adverse events in the patient.

For Souza et al., (2018). considers large cannulas as a risk factor for extravasation because they can reduce blood flow and infusion, however, other authors such as Brito, consider there is no agreement to choose the shorter device because it is safer, so they should be to previously assess the age, vascular characteristics of the patient and the infusion time, the use of plastic cannulas, are recommendations that the guidelines reinforce what is mentioned by the autor.

The guide mentions the place where the forearm puncture should be performed, preferably a prominent vein of the middle zone, starting from the distal to proximal zone. The veins of the dorsum of the hand and the ante ulnar fossa should be avoided, because in case of extravasation it is very likely to damage tendons, ligaments and nerves as there is little subcutaneous tissue, it is also advisable to avoid the veins of the lower extremities, joints. Children's Hospital Guide.
The contrast medium is considered a drug with high osmolarity index for which Márquez describes the types of contrast that exist in the market being the safest for administration is IODOPAMIDOL due to its osmolarity levels that resemble the body, this data is reinforced by Souza in his

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published article, he also mentions that extravasations are more frequent with ionic and hyperosmolar contrast media than with non-ionic contrast media of low osmolality. Non-ionic iodinated contrast media (ICM) usually cause little pain and the extravasation, at the beginning, may not be noticed by the patient. The guidelines reviewed aim to train healthcare personnel in the correct peripheral cannulation and timely management of extravasation, taking into account the condition of the oncologic patient.

The oncological patient is dynamic as mentioned by Alfaro-Rubio et al., (2006), due to the treatment undergone, whether it is surgical due to the limitation for the insertion of the peripheral route, the chemotherapy treatment generates weakness in the adventitial wall of the vein and risk of bleeding when the person is in Nadir, the radiotherapeutic treatment in the same way causes weakness in the elasticity of the wall of the vein. Finally, and of absolute importance, is the competent professional of the administration, the nurse, since he/she can be the main risk factor for extravasation, with the legal implications and damage to patients that this entails. The characteristics to be highlighted are: (18,23,36) Constant updating of knowledge on best practice, techniques, signs and symptoms, in order to reduce or eliminate the risk of extravasation, as far as possible. - Intravenous puncture skills, so as to minimize the risk of multiple punctures and the risk associated with them. - Good central venous catheter handling, having familiarity with central venous catheters. Avoid interruptions or distractions during the administration of contrast medium, thus avoiding omitting characteristic signs and symptoms.

Finally, the literature review makes visible the importance of this information is based on the verification of the prevention and treatment in the existing intravenous contrast extravasation can influence the behavior of the members of the nursing teams to be systematized in clinical practice. It is important to educate the patient and the family since it makes them aware of the most pertinent care to minimize the risks of extravasation, in addition, knowing the possible consequences of an extravasation makes them put more effort in taking care of the venous access and they cooperate in promptly reporting the event of an extravasation, which allows a timely detection and rapid care that minimizes the risks of tissue damage and physical and functional sequelae for the patient (Garrido, et al., 2020). Staff training allows them to realize the importance of acting quickly with full knowledge of the events following the instructions of the institutional protocols that allow their safety. More safety in decision making and in the case of facing an extravasation, not losing sight of any aspect, because the success in minimizing the risk of harm to the patient depends on it.

5. Conclusions

Extravasation is an infrequent complication; despite its low incidence, complications can be serious, and prevention measures by Radiology personnel are of vital importance. It is important the knowledge of prevention and treatment to be taken into consideration by nursing professionals in extravasation by means of intravenous contrast which provides feedback about the processes that determine it, allowing, in addition, to introduce planned changes in the attitudes and behaviors of the nursing teams.

The knowledge of prevention and treatment to be taken into consideration by nursing professionals in the extravasation of intravenous chemotherapy provides feedback about the processes that determine it, allowing, in addition, to introduce planned changes in the attitudes and behaviors of the nursing teams. The importance of this information is based on the verification that the prevention and treatment in the existing intravenous chemotherapy extravasation can influence the manifest behavior of the members of the nursing teams as it can be systematized in the clinical practice.

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