REUE | Original Article

Nurse administration of drugs in an advance life support ambulance on orders from a physician in an emergency response coordination center

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BACKGROUND AND OBJECTIVES. Advanced life support (ALS) ambulances are equipped to allow trained nurses to provide life-saving protocols. Among the critical components of ALS ambulance care is advanced administration of medication prescribed by a doctor at an emergency response coordination center (ERCC) based on nurse evaluation of the patient. This study aimed to analyze the safety and efficacy of administering drugs under these conditions and to determine the level of compliance with recommendations for controlling pain.

MATERIAL AND METHODS. Prospective observational descriptive study in patients attended by ALS ambulances during 1 year. A total of 241 cases were analyzed.

RESULTS. No records of adverse events related to medication administered were found. Patients improved in 72.8% of the cases included, and pain decreased by 2.13 points on a verbal numerical scale in those provided with analgesia. Care provided from the ALS ambulances resolved 92.5% of the health emergencies analyzed without need for attendance by a physician-led ambulance team.

CONCLUSION. Our observations show that ALS ambulance care is effective, improving symptoms in most patients without leading to adverse events after nurse administration of drugs. These ambulances can allow ERCCs to optimize deployment of intensive care ambulances.

Keywords: Advanced life support nursing. Nursing. Ambulance services. Emergency medicine. Medication administration. Medication prescription. Pain assessment.

Administración farmacológica por una unidad de soporte vital avanzado enfermero con prescripción médica desde el Centro Coordinador de Urgencias y Emergencias

INTRODUCCIÓN. Los recursos de soporte vital avanzado enfermero (SVAE) son ambulancias preparadas para prestar cuidados de soporte vital avanzado lideradas por un profesional de enfermería. Uno de los puntos críticos durante la asistencia por parte de estas unidades, es la administración de medicación sujeta a prescripción médica. Dicha prescripción, debe realizarla una/un médico del Centro de Coordinación de Urgencias y Emergencias (MCCUE) telemáticamente y tras ser informado de la valoración del paciente por parte de la/el enfermera/o de la unidad. El objetivo de este estudio es analizar si el recurso SVAE es eficaz y resolutivo en estas condiciones de trabajo. Como objetivos específicos, describir si se cumplen las recomendaciones para el control del dolor y si se optimiza la movilización de unidades medicalizadas extrahospitalarias.

MATERIAL Y MÉTODOS. Se realizó un estudio observacional, descriptivo y prospectivo de una serie de casos que incluyó a los pacientes atendidos por una unidad SVAE durante un año. Se seleccionaron un total de 241 casos.

RESULTADOS. No se registró ninguna reacción adversa derivada de la administración de medicación y la evolución clínica de los pacientes mejoró en el 72,8% de los casos. En los pacientes que se administró analgesia, se produjo una disminución de 2,13 puntos en la Escala Verbal Numérica (EVN) del dolor. Por otro lado, en los casos seleccionados, el recurso SVAE fue resolutivo sin necesidad de la colaboración de unidades medicalizadas presenciales en el 92,5% de los casos.

CONCLUSIONES. Tras nuestros resultados, se observó que el SVAE es un recurso eficaz, consiguiendo una mejoría clínica en la mayoría de los pacientes y sin reacciones adversas derivadas de la administración farmacológica. Además, se trata de un recurso asistencial resolutivo y que optimiza la movilización de unidades medicalizadas.

Palabras clave: Soporte vital avanzado enfermero (SVAE). Enfermería. Ambulancia. Emergencias. Administración de medicación. Prescripción de medicación. Evaluación del dolor.

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Introduction

The main objective of emergency nurses is to provide quality nursing care to patients in urgent and/or emergency situations where health deterioration occurs.[1] The advanced life support nursing units (ALSNU) are a type of out-of-hospital emergency care resource, defined in Spain by Royal Decree 836/2012 as Type C ambulances, designed to provide advanced life support (ALS), staffed by a driver/technician (TES) and a nurse. Additionally, a physician must be included when the situation requires it.[2] An ALSNU is equipped with all necessary materials to deliver ALS care, with the nurse leading the unit, performing techniques, and providing ALS-level assistance and care.[3]

These units began operating in the Spanish health care system about three decades ago and have evolved differently across the various Autonomous Communities.[3] In the Valencian Community (Spain), a pilot period started in 2018 with one unit in the metropolitan area of Valencia.[4] After a phase of adaptation and development, since January 2021, the Emergency Service of the Valencian Community (SES-CV) has had 3 ALSNU units, 1 in each province: Alicante, Valencia, and Castellón. They are equipped with full ALS material and staffed by 2 TES technicians and 1 nurse,[5] the latter with mandatory specific emergency training through a certification course provided by *Escuela Valenciana de Estudios para la Salud*.

During patient care provided by ALSNU, one of the main critical points is the administration of drugs that legally requires a medical order, since there is no physician physically present to issue the prescription. It is the nurse's responsibility to assess the patient's condition and report it via telephone or radio communication to the Medical Coordinator of the Emergency Response Coordination Center (ERCC) in charge of the incident. If deemed necessary, the ERCC gives a verbal prescription, which is recorded on the SES-CV server.

To date, few studies in Spain have analyzed medication administration, problem-solving capacity, and pain management in prehospital settings, and those that exist differ from the ALSNU model.[6-8] Some international studies have addressed similar units,[9-11] but evidence remains scarce.

The objective of this study was to analyze whether the ALSNU unit is effective and capable of resolving cases requiring pharmacological treatment prescribed verbally by an ERCC.

Specific objectives included: assessing compliance with pain management recommendations, and determining whether the ALSNU optimizes the deployment of medicalized prehospital units.

Material and methods

We conducted an observational, descriptive, and prospective study. The sample included all emergency calls received over one year (May 1, 2022 – April 30, 2023) from El Altet, a district of Elche (Alicante, Valencia, Spain), through the 112 Valencian Community emergency number. Initially, a 112 dispatcher assigned a priority level to the call, which was then forwarded to the Emergency Coordination Center (ECC), where the ERCC determined the most appropriate resource for response.

Inclusion criteria: cases in which the ERCC prescribed a drug to be administered by the ALSNU nurse. Exclusion criteria: drug prescribed by a physician outside the ECC or cases without medication during the intervention.

The following variables were analyzed: patient age, type of service (primary or secondary), initial priority assigned to the case, type of pathology treated, and type of medication administered; whether medicalized resources were physically involved during the intervention; whether the patient was transferred to the hospital and which type of unit performed the transfer. To measure the effectiveness of the interventions performed by the unit, it was documented whether any adverse reactions occurred in the patient following drug administration, and whether there was clinical improvement, stabilization, or deterioration after treatment. This variable was assessed through the evolution of the patient's vital signs and the remission, improvement, or worsening of the clinical condition that prompted the emergency call.

In the specific case of analgesic administration, pain intensity was evaluated using the Verbal Numerical Scale (VNS), recording the initial and final pain scores reported by the patient and the time elapsed between both assessments.

Data were analyzed using the Statistical Package for Social Sciences (SPSS), Version 22. A descriptive analysis was conducted by calculating frequencies and percentages for qualitative variables, and the mean and standard deviation for quantitative variables.

The data analyzed in this study were collected and handled in accordance with patients' rights to personal data protection and in full compliance with the ethical principles of the Spanish Nursing Code of Ethics[12] and Law 41/2002 of November 14, the basic law regulating patient autonomy and rights and obligations regarding clinical information and documentation.[13]

Results

Of the 1,080 cases collected, a total of 241 patients met the inclusion criteria. The mean age was 62.7 years (SD, ± 21.7). The age distribution of the selected patients, in 20-year intervals, is shown in Figure 1.

In 98.3% of cases (n = 237), the assistance provided was primary care, meaning care delivered at the site of the emergency, with transfer to an appropriate hospital if necessary. In 1.7% of cases (n = 4), the prescription was issued during inter-hospital transfers.

The initial priorities assigned were as follows: priority 1 (life-threatening condition) in 61% (n = 147); priority 2 (potentially life-threatening but not imminent) in 24.9% (n = 60); priority 3 (non–life-threatening but not deferrable process) in 7.5% (n = 18); priority > 4 (non–life-threatening or non-urgent process) in 4.1% (n = 10); and no priority was assigned in 1.7% (n = 4) due to these being secondary transfers.

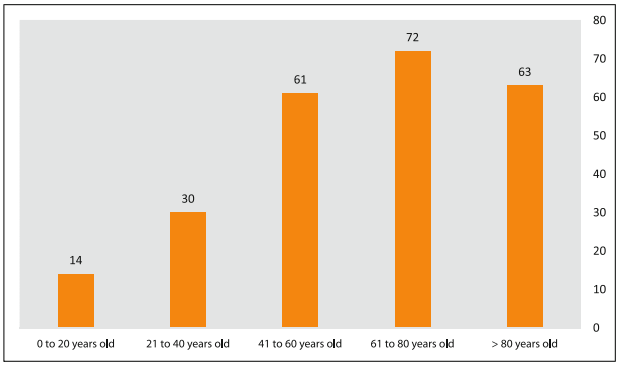

Figure 1. Frequency distribution by age range of patients treated by the advanced life support nursing units, under verbal pharmacological prescription from the medical coordinator of the Emergency Coordination Center.

Table 1 details the various pathologies treated by the ALSNU, classified by pathological group. The most frequent conditions were traumatological pathology (21.2%), altered level of consciousness (11.6%), cardiac pathology (11.6%), and respiratory disease (10.8%).

A total of 380 drugs were administered (Table 2), with the most common being fluid therapy (36.0%), analgesics (14.7%), and antiemetics (10.5%). In 100% of cases (n = 241), no adverse reactions were recorded following medication administration. Clinical improvement was observed in 72.8% of patients (n = 166), the clinical condition remained unchanged in 27.2% (n = 62), and in no case was there documented clinical deterioration after drug administration.

Analgesia was administered in 21.2% of cases (n = 51). Of these, initial and final VNS pain scores and the elapsed time between both assessments were recorded in 36 cases. Pain improvement was observed in 91% (n = 33), with a mean initial VNS score of 7.88 (SD, ± 1.38) and a final score of 5.75 (SD, ± 1.76), representing an average decrease of 2.13 points. In 22.2% (n = 8) of cases, the final pain score was < 4. The mean time between the initial and final assessments was 17.2 minutes (SD, ± 7.6).

In 92.5% (n = 218) of cases, no medicalized emergency resources were physically involved. In the remaining 5.8% (n = 14), a medicalized ALS unit was involved—activated 4 times by the ECC and requested by the ALSNU in 10 cases (of these, 7 patients were transferred by the ALS unit and 3 by the ALSNU). In 1.6% (n = 4) of cases, a primary care medical team intervened.

As shown in Table 3, after initial assistance, 78.4% of patients were transferred by the ALSNU, 4.1% by a Basic Life Support (BLS) unit, and 3.7% by a medicalized ALS unit. In 9.5% of cases, no hospital transfer was required following initial care.

Discussion

In our study, no adverse reactions were recorded, and most patients showed clinical improvement after pharmacological administration. The resolution rate without the need for medicalized units was 92.5%. In the remaining 7.5%, when the ALSNU requested a medicalized ALS unit, 70% of those cases resulted in transfers by that unit. These findings demonstrate the effectiveness and problem-solving capacity of the ALSNU resource in collaboration with the ERCC, as well as the clinical judgment and skill of ALSNU professionals in determining which situations re-

Table 1. Frequency and percentage of conditions treated by the advanced life support nursing units under pharmacological prescription from the medical coordinator of the Emergency Coordination Center

	Absolute frequency	Percentage
Traumatologic	51	21.2%
Altered level of consciousness	28	11.6%
Cardiologic	28	11.6%
Respiratory	26	10.8%
Neurologic	20	8.3%
Endocrine-metabolic	16	6.6%
Psychiatric	15	6.2%
General discomfort/dizziness	14	5.8%
Poisonings	13	5.4%
Digestive	8	3.3%
Blood pressure disorders	7	3.0%
Cardiorespiratory arrest	4	1.7%
Secondary transfers	4	1.7%
Non-traumatic pain	2	0.8%
Anaphylaxis	2	0.8%
Septic shock	1	0.4%
Stings and bites	1	0.4%
Unspecified	1	0.4%

Source: Authors' own data.

Table 2. Frequency and percentage of medications administered by therapeutic group in cases treated by the advanced life support nursing units under pharmacological prescription from the medical coordinator of the Emergency Coordination Center

	Absolute frequency	Percentage
Fluid therapy	137	36.0%
Analgesics	56	14.7%
Antiemetics	40	10.6%
Bronchodilators	32	8.4%
Corticosteroids	21	5.5%
Hypertonic glucose	16	4.2%
Anxiolytics	13	3.4%
Antidotes	9	2.4%
Sedatives	8	2.1%
Antihypertensives	6	1.6%
Antipyretics	6	1.6%
Vasoactive agents	6	1.6%
Antiarrhythmics / Beta-blockers	4	1.0%
Nitrites	4	1.0%
Sulpiride	4	1.0%
Antiplatelet agents	4	1.0%
Anticonvulsants	3	0.8%
Antihistamines	3	0.8%
Atropine	2	0.5%
Activated charcoal	2	0.5%
Glucagon	1	0.3%
Insulin	1	0.3%
Omeprazole	1	0.3%
Anticoagulants	1	0.3%

Source: Authors' own data.

Table 3. Frequency and percentage of outcomes after initial care of patients treated

	Frequency	Percentage
Transfer by ALSNU	189	78.4%
On-site assistance	23	9.5%
Transfer by BLS Unit	10	4.1%
Transfer by medicalized ALS unit	9	3.7%
Voluntary discharge	5	2.1%
Deceased	2	0.8%
Transfer by own means	1	0.4%

Source: Authors' own data.
ALSNU: Advanced Life Support Nursing Unit; BLS: Basic Life Support; ALS: Advanced Life Support.

quired a medicalized ALS resource. The literature on other nurse-led prehospital emergency units also shows high resolution rates when working in collaboration with an ERCC. In the study by Marín Bernard *et al.*[4] in the SES Valencia (Spain), 81% of patients were transported by the ALSNU, and only 8% required transfer by a medicalized unit. In Andalusia, other systems demonstrated a high rate of on-site resolution without transfer, also in collaboration with ERCCs, although 75–80% of these cases were classified as mild diseases or conditions.[6-8] Our results also indicate that the ECC effectively selected the most appropriate care resources to address each incident. In this regard, it would be worthwhile to further evaluate which types of emergencies can be effectively resolved by ALSNUs to optimize prehospital resource allocation.

In the study by Pacheco *et al.*[14], conducted in several Spanish emergency departments, the prevalence of treated conditions and the patients' mean age were very similar to those seen in our results. Similarly, studies conducted in the Valencian Community[4,15] reported comparable findings regarding both pathology types and patient age.

Spanish studies on nurse-led prehospital emergency teams analyzing, among other variables, the type of medication administered, generally agree that—excluding fluid therapy—analgesics are the most frequently used drugs. However, differences exist in other medications, likely because most of those studies involved patients with mild conditions.[6,7]

Regarding pain management, our results showed a mean reduction of 2.13 points in the VNS, with a mean interval of 17.2 minutes between the initial and final evaluations. Several Spanish studies on emergency services highlight the importance of pain assessment in prehospital emergency care using VNS.[16,17] However, therapeutic goals for pain control in the literature are diverse and not standardized. The clinical practice guideline published by Pandharipande *et al.*[18] (2023) states that the main goal of analgesia is to provide optimal patient comfort, depending on clinical condition, pain tolerance, and side effects of analgesic therapy—without specifying quantitative targets.

Conversely, the Pain Working Group of SEMES (Spain), in its 2018 guideline,[19] specifies that, in emergencies, pain control can be considered adequate when the reduction is at least 2 points from baseline or when the pain level is < 5. Similarly, studies by Mota *et al.*[9] and Hossfeld *et al.*[20] set the clinical target after analgesia as achieving a pain score < 4 or a reduction of at least 3 points on the VNS. Thus, the reviewed literature reveals discrepancies in defining therapeutic goals for analgesia in pain control.

In the study by García del Águila *et al.*,[17] conducted in Andalusia (Spain) in medicalized units, the mean reduction in pain was 4 points on a numerical scale. Other countries have also studied nurse-led ALSNU units. In Portugal, an analysis of cases receiving analgesia showed a mean pain reduction of 2.44 points[9] between the initial and final assessments. In Sweden, Johansson *et al.*[10] analyzed inhaled analgesic therapies in ALSNU units, reporting a 3-point reduction on a numeric scale, with a mean transfer time of 29 minutes. In Italy, Imbriaco *et al.*[11] found that 46% of Italian ALSNUs operate with analgesia protocols, allowing nurses to initiate treatment before physician intervention. These protocols have been extensively studied, proving safe and effective, and could represent a potentially valuable approach for future implementation in Spain.

No sample size calculation or inferential analysis was performed, and the severity of attended cases was not assessed. Nevertheless, to our knowledge, this study is among the few published works analyzing medication administration and pain control by an ALSNU unit under verbal prescription by an ERCC. It highlights the importance of further research into the problem-solving capacity of ALSNU units and their clinical impact when assessing and treating patients in collaboration with an ERCC. Future prospective, multicenter studies involving EMS where ALSNU units are already implemented are recommended.

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