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Conflict of interest

No conflicts of interest exist in relation to the study or this paper.

Ethical considerations

Ethical clearance for the study was granted by the University of Johannesburg's Faculty of Health Sciences Academic Ethics Committee.

Protection of Patient's Rights to Privacy

The researcher signed a confidentiality agreement stating that the information which he had access to remained confidential. In light of the research design it was not necessary to identify individual students, patients, supervising practitioners, emergency medical service providers or receiving medical facilities. The researcher only extracted data from the database on the premises of the University of Johannesburg. The files remained password-protected and were deleted after data extraction was completed.

STUDENT COMPLIANCE WITH TAUGHT INDICATIONS FOR INTRAVENOUS CANNULATION DURING CLINICAL LEARNING

Keywords: Intravenous, Cannulation, Indications, Overtreatment, Student, Skill Mastery

Abstract / Summary

Background:

One of the guiding principles behind the teaching and performance of a medical intervention is to “*firstly do no harm*”. Gaining access to a patient’s circulatory system for the purposes of administering fluid and / or medications is commonly achieved through a procedure that involves piercing the skin with a needle and inserting a cannula into a vein. Whilst intravenous (IV) cannulation remains a relatively common procedure, routinely performed by a number of health care professionals, it has the potential to create unintended adverse effects. Subjecting patients to medical procedures in the absence of a clearly established need may be considered an unethical form of “*overtreatment*”. Conversely, failing to perform an intervention when it is clearly indicated is equally undesirable. For this reason, it is important that medical professionals and educators ensure a real need or indication for IV cannulation exists prior to the performance of the procedure by students. The University of Johannesburg (UJ) is one of four higher education institutions in South Africa that currently offer a four-year professional bachelor degree in emergency medical care. Intravenous cannulation is a clinical procedure that is taught in the second year of study. The didactic approach followed at the UJ is to firstly teach and assess theoretical knowledge and understanding relating to the procedure with regard to the technique, indications, risks and benefits. The procedure is then demonstrated, practiced and assessed in a simulated environment making use of an intravenous trainer (medium fidelity manikin). Thereafter students are required to demonstrate performance of the procedure a set number of times on real patients. Whilst this naturally creates a desire in students to perform IV cannulation when the opportunity presents itself, as mentioned above, seeking clear indications for the performance of the procedure is essential to prevent unnecessary exposure of patients to potential adverse effects. The Department of Emergency Medical Care at the UJ currently teaches four indications for intravenous cannulation in the pre-hospital setting which are well supported by literature. These include: a) the administration of intravenous fluid in an effort to reverse hypovolaemic and associated dehydrated states, b) administration of intravenous medications, c) securing intravenous access in the case of acutely-ill, high-acuity “*priority 1*” or “*code red*” patients and d) obtaining blood samples/specimens for further laboratory testing. The authors aimed to assess the extent to which emergency medical care students may have been establishing IV access on patients during the course of their clinical learning without a clear indication.

Objective:

This study investigated whether or not emergency medical care students were complying with the taught indications for intravenous cannulation during their clinical learning interactions based on their documented clinical assessment, categorization and interventions.

Methods:

Data from an existing database, *Emergency Medical Database and Analysis System (EMDATA)* was used to retrospectively investigate whether or not patients seen by students over a two-year period received intravenous cannulation in line with the taught indications.

Conclusion:

The study showed that of the 5893 patients seen, 1862 (32%) were cannulated intravenously. Of these, 426 (23%) did not have a clearly documented taught indication for the procedure. As a result, these patients may be considered to have been potentially “*overtreated*” by students.

Research Design and Method

A retrospective quantitative design was applied making use of 5893 cases from an existing database, *EMDATA*, which contains pre-hospital patient care records relating to student’s clinical learning facilitated by the Department of Emergency Medical Care at the University of Johannesburg. Data from two consecutive academic years was extracted using Structured Query Language (SQL) statements and analyzed in an attempt to establish the number and percentage of patients seen by students over that period who:

- a) received intravenous cannulation.
- b) received intravenous cannulation and intravenous medication but less than 500millilitres (ml) of fluid.
- c) received intravenous cannulation and more than 500ml of fluid but no intravenous medication.
- d) received intravenous cannulation, more than 500ml of fluid and intravenous medication.
- e) were cannulated and were acutely–ill, high-acuity “*priority 1*” patients, but did not receive more than 500ml of fluid or intravenous medication.
- f) received intravenous cannulation but who were not acutely-ill, high-acuity “*priority 1*”, nor did they receive intravenous medication or more than 500ml of fluid. This would constitute the cohort of patients for whom there was no clearly documented taught indication supporting performance of the procedure. **As a result based on the data extracted from the database, this is the cohort of patients who may have potentially been unnecessarily cannulated or “*overtreated*”.**

Results

Table 1 summarizes the cases per category.

TABLE 1: CASES PER CATEGORY

| Category | Number of cases (%) |
|--|---------------------|
| Total number of patients who were cannulated intravenously | 1862/5893 (32%) |
| Received IV Medications but not Fluid Resuscitation* | 431/1862 (23%) |
| Received Fluid Resuscitation* but no IV Medication | 590/1862 (32%) |
| Received Fluid Resuscitation and IV Medication | 289/1862 (16%) |
| Were categorised as high-acuity (P1) but received no IV Medications or Fluid Resuscitation* | 126/1862 (7%) |
| Received neither IV Medications, no Fluid Resuscitation and were not categorised as high-acuity (P1) | 426/1862 (23%) |

IV=Intravenous; P1=*Priority One* *Fluid Resuscitation was defined as the administration of more than 500millilitres of fluid;

Discussion

Research within the South African pre-hospital emergency care education environment is in its infancy. Consequently, there is currently limited published literature describing the practices of local emergency medical care students. In an attempt to compare the above findings to existing literature, the authors performed a literature search in the Medline database using medical subject headings (MeSHs) and text words: “Intravenous Cannulation” [MeSH] and “prehospital” [MeSH] and “emergency medical services” [MeSH]. Articles published over the last 15 years were prioritized. These searches highlighted limited international literature involving emergency medical care students and the performance of intravenous cannulation.

Patients who were cannulated intravenously.

The percentage of patients (32%) who received intravenous cannulation in this study was found to be lower than the percentage in other international studies. Gausche and colleagues found that 84% of the patients in their study received intravenous cannulation.¹ Two other studies found that peripheral intravenous cannulation had been performed in 57% and 58% of patients respectively.^{2,3}

The lower percentage of patients who received intravenous cannulation in relation to international figures may be because, in South Africa, ambulances transport many low-acuity “stable” ambulatory patients who do not require any form of pre-hospital medical intervention but simply need transport to the hospital.⁴ Another factor for this low percentage may be due to instances where students end up working with ambulance crews whose scope of practice does not include intravenous cannulation. As students may only practice within

the scope of the registered supervisor, they would not have been able to perform this skill even if it were indicated.

Patients who were cannulated intravenously, received intravenous medication but less than 500 millilitres (ml) of fluid.

The 23% of patients in this category were seen to be fewer than the 71% of patients who received only intravenous medication in the Minville *et al.* study.² One reason for this may be because many of the ambulance crews in South Africa with whom the students were working were qualified at an Intermediate Life Support level. South African Intermediate Life Support providers have few intravenous medications in their scope of practice yet are still able to establish an IV line.

Patients who were cannulated intravenously and who received more than 500ml of fluid where no intravenous medication was administered.

Of the patients who were cannulated 32% received fluid resuscitation. This is higher than the percentage reported in similar international studies, where only 7% and 5% of patients received fluid resuscitation respectively.^{1,2} The difference may be attributed to the higher incidence of trauma (with associated blood loss) to which South African emergency services respond. South Africa has one of the highest motor vehicle accident rates in the world. Violence and injuries are the second leading cause of death and lost disability-adjusted life years in South Africa. The overall injury death rate of 158 per 100 000 population is nearly twice the global average.⁵ Another possible reason may be that local Basic and / or Intermediate Life Support providers spend longer in the pre-hospital environment than their international counterparts.⁶ Simply put, additional time spent treating and transporting patients allows for more fluid to be administered.

Patients who received more than 500ml of fluid together with intravenous medication.

Two hundred and eighty nine (16%) of the patients in the study received both intravenous medication and more than 500ml of fluid. This finding could not be compared to international studies, as the studies reviewed did not identify these patients as a separate group.

Patients who were acutely-ill, high-acuity “priority 1” patients and were cannulated intravenously but did not receive more than 500ml of fluid or any intravenous medications

As mentioned previously one of the taught indications for establishing intravenous access is obtaining intravenous access in the acutely-ill, high-acuity “priority 1” patient so that should rapid deterioration occur during transit the IV line is already in place. One hundred and twenty six (7%) of the patients who received intravenous cannulation were categorized as high-acuity “priority 1” but did not receive any intravenous medication or more than 500ml of fluid. This is much lower than the 24% described in the Minville *et al.* study.² Reasons for this difference are not clear. One possible reason could be related to a failure by ambulance personnel and students to properly assess the patient and correctly predict deterioration.

Patients who were cannulated intravenously yet were neither categorised as high-acuity “priority 1” nor did they receive intravenous medication or more than 500ml of fluid (i.e. none of the taught indications appear to be present.)

Four hundred and twenty eight (23%) of the patients in this study did not have a clearly documented “taught indication” for IV cannulation. This evidence suggests that these patients may have been potentially “overtreated”. Such a finding is similar to the 22% and 29% of intravenous lines that remained unused in the studies by Allen *et al.* and Pace *et al.* respectively.^{3,7} However, this was considerably lower than the 56% of unused IV lines found in the Gausche and colleagues study.¹

As mentioned above there is a paucity of literature describing the clinical education and training practice of emergency medical care students. Despite a number of searches, no literature could be found describing overtreatment of patients by emergency medical care students. Reasons for overtreatment may include over eagerness on the part of the student and a desire to “practice” and master newfound clinical skills.

McGaghie, Barsuk and colleagues, in dealing with medical education and learning, highlight the potential of simulation based learning to assist in achieving minimum standards and mastery of clinical skills prior to interactions with real patients. McGaghie rightfully notes that whilst many medical education programmes demand the performance of set numbers of skills and procedures by students more often than not these numbers are not scientifically validated.^{8,9} Nonetheless, the setting of minimum numbers naturally creates pressure on student and educator alike to achieve such. Observations and feedback from students and educators in our emergency medical care environment are that there is indeed pressure to perform skills and interventions for purposes of teaching, learning and assessment.

This study showed that of the 5893 patients seen by students during the two-year period 1862 (32%) received intravenous cannulation and of these, 426 (23%) did not have a clearly documented taught indication for the procedure. This evidence suggests that these patients may have been potentially “overtreated”. Subjecting patients to medical procedures in the absence of an evidence-based need may be considered an unethical form of overtreatment. Conversely, failing to perform an intervention when it is clearly indicated is equally undesirable. For this reason, it is incumbent on medical professionals and educators to ensure a real need or indication for procedure such as intravenous cannulation exist prior to the performance of this procedure by students. It is also acknowledged that emergency medical care students work under direct supervision. The power / authority relationship between themselves and their clinical mentors in the field may limit their autonomy to make clinical decisions. Such findings are interesting and applicable to not only emergency medical care students and educators.

Medical educators should consider recent evidence and work taking place in the area of simulation based learning, as this appears to be an under-utilized didactic approach which if properly implemented may reduce our current overreliance on patient contact.

Conclusion

Of all the patients who were cannulated intravenously, few were found to have had medications administered via the established IV line. A higher number of patients received more than 500mls of fluid compared to similar international studies. There were a number of patients who had an IV line established, yet they did not receive medications or clinically significant volumes of fluid nor were they documented as acutely-ill, high-acuity “*priority 1*”. In such cases the indication to perform this procedure was unclear, and thus these patients

may well have been “*overtreated*”. Whilst intravenous cannulation remains a relatively common procedure routinely performed by a number of health care professionals it still has the potential to create unintended adverse effects. This study demonstrates that a significant number of IV lines were established by students with no clearly documented indication. This potential overtreatment may in part be attributed to pressures placed on students to achieve minimum prescribed numbers of skills. The value of quantitative approaches to determine clinical competence based purely on the performance of a skill or procedure a set number of times may be questioned for many of the targets set are not scientifically validated. Despite this, such practices remain common in medical education and may be detrimental to the patient. Medical educators need to ensure that their students value the patient rather than the procedure. Further research needs to be conducted to investigate and identify other possible reasons for overtreatment of patients by medical students.

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