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Experience and Availability of Pelvic Binders at Swedish Trauma Units; A Nationwide Survey

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ABSTRACT

Objective: To assess availability, experience, and knowledge about the Pelvic Circumferential Compression Device (PCCD) in Sweden.
Methods: A telephone interview with the current on-call trauma doctors at all trauma units in Sweden was conducted. After a short presentation and oral consent, the doctors were asked to answer four short questions. We asked the doctors to answer whether they knew if they had PCCDs available in their emergency room, how many times had they applied a PCCD, which is the correct level of application for a PCCD, and if a PCCD can stop arterial bleeding.
Results: The on-call trauma doctors at the nine University hospitals, twenty-two General hospitals and twenty-one District General hospitals, with response rate of 100%, were interviewed. Availability of PCCD was 85 % and there was no difference between hospital types (p=0.546). In all hospitals 29/52 (56%) of those interviewed had used a PCCD at least once. There were significantly more doctors that had used a PCCD at least once in the University hospitals (8/9), compared to General hospitals (13/22) and District General hospitals (8/21) (p=0.034). A total of 43/52 (83 %) doctors defined the greater trochanters as the correct level of application for a PCCD. No difference was found when comparing hospitals (p=0.208). Only 22/52 (42 %) of doctors answered that a PCCD could not stop an arterial bleeding. No difference was found between hospitals (p=0.665)
Conclusion: Less than half of the doctors knew that a PCCD cannot stop arterial bleeding, while the majority knew the correct level of application of a PCCD.

Keywords: Interview as topic; Trauma centres; Statistics and numerical data; Pelvic bones; Pelvic injuries; Advanced trauma life support care; Humans.

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Introduction

High-energy pelvic injuries are rare, and the incidence has been reported to be 10/100000 persons [1]. Traumatic Pelvic Ring Injuries (TPRIs) with ongoing bleeding can be lethal injuries, and the reported mortality rate following these injuries can be as high as 47-48% [2, 3]. The initial management of TPRIs at the trauma units in Sweden follow the ATLS (Advanced Trauma Life Support) protocol

[4]. This protocol includes application of a Pelvic Circumferential Compression Device (PCCD) in patients with suspected, or verified, pelvic fracture [4]. Physiologically unstable patients with pelvic fractures and ongoing arterial bleeding need further laparotomy or angiography [4].

The ATLS protocol has been shown to improve doctors' knowledge and performance regarding acute management of poly-trauma patients [5]. Decreasing the intra-pelvic volume in patients with pelvic injury is the idea behind the application of a PCCD [6]. To achieve maximum mechanical stability in a disrupted pelvic ring it is recommended that PCCD be applied at the level of the greater trochanters [6]. Previous studies have reported that there is a lack of knowledge about when to use and how to apply the PCCDs correctly [7, 8]. The aim of this nationwide study was to assess the availability of PCCDs in Swedish trauma units, and to assess the level of knowledge and experience of the first level doctors in charge of acute management of trauma patients.

Material and Methods

Study Population

A list of all hospitals with trauma units in Sweden was collected (www.oturen.se). The hospital types were defined as: "University hospitals" (hospitals connected to a dedicated university, who could have several counties in their assigned area), "General hospitals" (hospitals responsible for the entire population of a county) or "District General hospitals" (hospitals responsible for a restricted area inside a particular county) [9]. The study was performed during the daytime, Monday to Friday, during the month of September 2016. Via the hospitals local switchboard, the current on-call doctor in charge of the primary management of trauma patients was contacted. After oral consent from the on-call doctor, a structured telephone interview was conducted. Initially he/she was asked about their level of experience, which was categorized as: "Interns" (those who had finished their medical school and were under training to achieve full registration), "Residents" (doctors under training to become a specialist in a particular specialty) or "Specialist" (holders of a specialist certificate). Thereafter, four questions about the availability, experience, and knowledge of PCCDs were asked: Question 1: "Do you have a PCCD in your emergency room?" represents resource availability. Question 2: "How many times have you applied a PCCD?" represents experience. Question 3: "Which is the best level of application for a PCCD?" represents knowledge, and we considered the level of the greater trochanters as the correct level. Question:4 "Can a PCCD stop arterial bleeding?" represents knowledge, and we considered "No" as the correct answer (Table 1). All responses were anonymized after collection.

Ethics

The study was conducted according to the Helsinki declaration and approved by the local Ethics Committee of Stockholm, Sweden, reference number 2017/380-31/2. All the individuals who participated, were guaranteed anonymity and that all results would be presented in groups.

Statistical Methods

Nominal variables were tested by the Chi-square test. All tests were two-sided. The results were considered significant at $p<0.05$. The statistical software used was IBM SPSS Statistics, Version 23 for Windows (SPSS Inc., Chicago, Illinois).

Results

In total 52 hospitals were identified as having a trauma unit in Sweden (9 University hospitals, 22 General hospitals, and 21 District General hospitals). All 52 primary on-call doctors could be reached, and they all agreed to participate in the study and thereupon answered all of the questions. The level of experience of the on-call doctors on the day the hospital was contacted was: 20 Specialists (6 University hospitals, 9 General hospitals, 5 District General hospitals), 15 Residents (1 University hospital, 7 General hospitals, 7 District General hospitals) and 17 Interns (2 University hospitals, 6 General hospitals, 9 District General hospitals). There was a larger proportion of Specialists serving as on-call doctors at the University hospitals (67%) compared to the other hospitals (33%) but this was not statistically significant ($p=0.071$) (Figure 1).

Question 1

A PCCD was available in 44/52 (85 %) of all the hospitals. Eight doctors gave the answer "Unsure". Using the respective hospital type the doctors interviewed knew that a PCCD was available in 7/9 of the University hospitals (5 Specialists, 1 Resident, 1 Intern), in 20/22 (7 Specialists, 7 Residents, 6 Interns) of the General hospitals and in 17/21 (4 Specialists, 6 Residents, 7 Interns) of the District

Table 1. Questions and response options

No	Question	Response option
1	Do you have a PCCD[a] in your emergency room?	Yes, No, Unsure
2	How many times have you applied a PCCD?	1-5, >5, Never
3	Which is the best level of application for a PCCD?	Greater trochanters, Iliac crest, Unsure
4	Can a PCCD stop an arterial bleeding?	Yes, No, Unsure

[a]PCCD: Pelvic Circumferential Compression Device

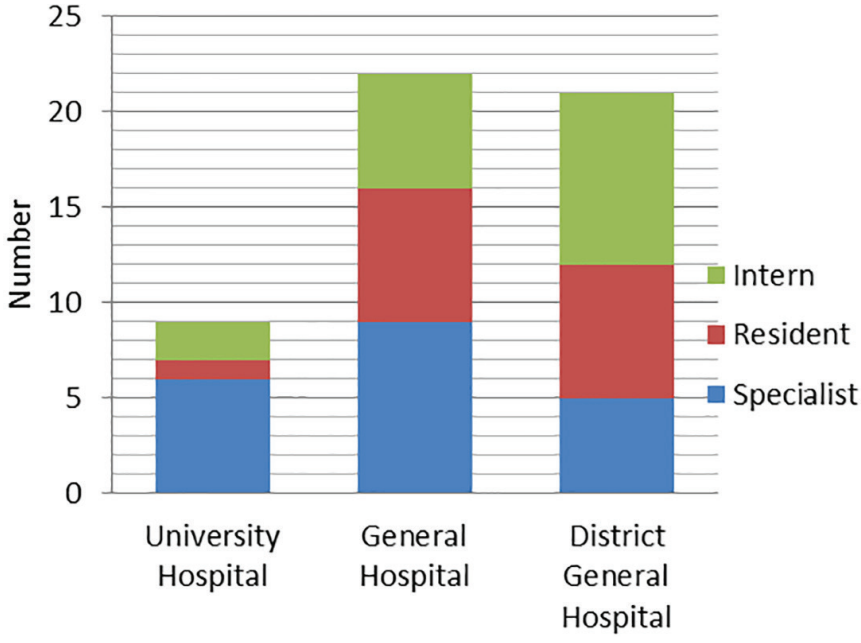

Fig. 1. Figure represents 3 levels of hospitals in Sweden. Axis is stacked by number of 3 levels of doctors in different hospitals. Y-axel represents the number of doctors.

General hospitals (p=0.546).

Question 2

In all hospitals, 29/52 (56 %) of those who were interviewed had used a PCCD at least once. There were significantly more doctors that had used a PCCD at least once in the University hospitals (8/9, 6 Specialists, 1 Resident, 1 Intern), compared to General hospitals (13/22, 8 Specialists, 3 Residents, 2 Interns) and District General hospitals (8/21, 3 Specialists, 5 Residents, 0 Interns) (p=0.034). In the University hospitals 5/9 (3 Specialists, 1 Resident, 1 Intern) had used a PCCD 1-5 times and 3/9 had used it > 5 times (3 Specialists). In the General hospitals 10/22 (5 Specialists, 3 Residents, 2 Interns) had used a PCCD 1-5 times and 3/22 (3 Specialists) had used it > 5 times. In the District General hospitals 5/21 (2 Specialists, 3 Residents, 0 Interns) had used a PCCD 1-5 times and 3/21 (1 Specialist, 2 Residents, 0 Interns) had used it > 5 times.

Question 3

A total of 43/52 (83%) doctors defined the greater trochanters as the correct level of application for a PCCD. Divided by hospital type the numbers were 8/9 (6 Specialists,2 Residents, 1 Intern) in the University hospitals, 20/22 (8 Specialists, 7 Residents, 5 Interns) in the General hospitals and 15/21 (4 Specialists, 5 Residents, 6 Interns) in the District General hospitals (p=0.208).

Question 4

Twenty-two of 52 (42%) doctors answered that a PCCD cannot stop arterial bleeding. In the University hospitals the number was 5/9 (4 Specialists, 1 Resident, 0 Interns), in the General hospitals the number was 9/22 (7 Specialists, 1 Residents, 1 Intern) and in the District General hospitals it was 8/21 (4 Specialists, 2 Residents, 1 Intern) doctors (p=0.665).

Discussion

The main finding of our study was that the availability of PCCDs and the knowledge of how to apply it were acceptable and similar between the three hospital categories. This might reflect the fact that majority of doctors questioned have attended ATLS courses. However, less than half of the doctors interviewed knew its limitations in achieving hemodynamic stability with regard to differences between arterial versus venous bleeding.

Although a part of the widely used ATLS protocol, the literature regarding the availability, experience, and knowledge about use of PCCDs is sparse. We found a PCCD availability rate of 85 % in the Swedish trauma units. This was slightly higher than the 75-78 % that was reported 2013 in a study by Jain et al. including the results from a national survey in the UK [8]. However, taken into consideration that the ATLS protocol is well adopted in Sweden, as well as in the UK, it is somewhat surprising that the reported availability rate is not 100%. Following new telephone contacts with those eight trauma units who answered "unsure" regarding availability of PCCD, we found that PCCDs were indeed available at all of those centers. An explanation could be that wide prehospital application of PCCD reduces the chances of ER doctors to investigate the availability of PCCDs in their units [10]. However, while the data is shows that pelvic fractures might be missed in the prehospital setting the knowledge of the first line on-call doctors regarding availability of PCCD in ER is noteworthy [11]. The majority (56 %) of the

doctors reported that they had used a PCCD at least once. Furthermore, the fact that 3/22 doctors in the General hospitals and 3/21 doctors in the District General hospitals had used a PCCD more than 5 times illustrates that there is experience even in the smaller trauma units in handling high-energy trauma cases. One reason for this might be that Sweden is a country with some sparsely populated areas with sometime long distances to larger hospitals. Primary care of high-energy patients is then sometimes conducted at these smaller units, and transport to the definitive level of care happens only after initial physiological stabilization of these patients.

It is recommended that a PCCD is applied at the level of greater trochanters [4, 12, 13]. We found that 83 % of the doctors in our study defined the greater trochanters as the level of choice for application of a PCCD. This was a slightly higher compared to a previous report [8]. However, we had a substantial proportion of specialists (40 %) in our survey, contrary to Jain et al. who only had registrars in their study [8]. Somewhat surprising, we found that only 42 % of all the doctors knew that a PCCD couldn't stop arterial bleeding. This finding is somewhat startling as a hemodynamically unstable patient with a PCCD and multiple injuries might still suffer from an arterial pelvic bleeding. If the trauma doctor, then believes that the PCCD can stop an arterial pelvic bleeding. This might result in an unsafe patient situation. Grimm et al. in a cadaveric study reported a maximum of 30mmHg intra-pelvic pressure upon reduction of a disrupted pelvic ring [14]. This pressure might be beneficial to stop the bleeding from fracture sites and sacral venous plexus but not from arterial bleeding [15]. There are 2 case series reporting physiological improvements following application of PCCD, both of which were conducted in major trauma centres with available resources to stop arterial bleeding [16, 17]. Angio-embolization, pelvic packing and arterial ligation have been reported useful in pelvic fractures with on-going arterial bleeding [18-20].

One strength of our study was the 100 % response rate. The strength of using a telephone interview is that it gives the opportunity to find information in real time without having to obtain the information by asking around and thus increasing the risk of bias. One limitation of our study was its cross sectional nature. The answers we received might represent the opinion of the particular individuals that we interviewed rather than representing the common practice in the trauma units. Another limitation is that there is always a more experienced backup doctor to the primary on-call trauma physicians, and these doctors were not asked.

In conclusion, our study shows that the majority of the hospitals had PCCDs available and the majority of the primary on-call doctors knew at which level to apply a PCCD. The experience in using PCCDs was greatest in the University hospitals. Less than half of those interviewed knew that a PCCD cannot stop arterial bleeding, a matter which highlights a need for educational improvement.

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Conflicts of Interest: None declared.

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