Int J Legal Med (2011) 125:857–861
DOI 10.1007/s00414-011-0613-2

ORIGINAL ARTICLE

A web-based e-learning programme for training external post-mortem examination in curricular medical education

Andreas Schmeling · Manuel Kellinghaus · Jan Carl Becker · Ronald Schulz · Angelika Schäfer · Heidi Pfeiffer

Received: 17 June 2011 / Accepted: 12 August 2011 / Published online: 8 September 2011

Abstract In Germany, the external post-mortem examination is considered a medical duty and may be performed by any licensed physician. Concerning legal medicine as a curricular subject in teaching medical students, the external post-mortem examination is regarded a core area. At the University of Müenster, 15 virtual cases of death have been developed by using the web-based Inmedea Simulator. The programme allows performing all relevant steps in executing a complete external post-mortem examination. A particular importance was attached to the aspect of training users in approaching the subject in a systematic way to interpret significant forensic findings correctly and to comprehend their medico-legal implications. The programme was used for the first time in the academic term of 2010/2011. The overall reception of the programme by the medical students resulted to be positive in a first evaluation.

Keywords External post-mortem examination · Curricular medical education · e-learning

A. Schmeling (✉) · M. Kellinghaus · R. Schulz · H. Pfeiffer
Institut für Rechtsmedizin,
Röntgenstraße 23,
48149 Münster, Germany
e-mail: Andreas.Schmeling@ukmuenster.de

J. C. Becker
Institut für Ausbildung und Studienangelegenheiten,
Albert-Schweitzer-Straße 21,
48149 Münster, Germany

A. Schäfer
INMEDEA GmbH,
Gerhard-Kindler-Straße 6,
72770 Reutlingen, Germany

Introduction

Curricular medical teaching in legal medicine for undergraduate students in Germany usually includes thanatology, forensic traumatology, forensic genetics, forensic toxicology and medical law. The external post-mortem examination is a classic topic of thanatology. Besides theoretical knowledge as it is presented in lectures, students are supposed to actually carry out an external post-mortem examination within the frame of a practical course.

The training in external examination of a body is of great importance since every licensed German physician may be obliged to execute this procedure. In case the examiner classifies the manner of death as unnatural or uncertain, he is obliged to report to the police. If natural death is certified, the body can be buried without being seen by a specialised medical examiner or police officer. Therefore the examiner in charge with the death case has a crucial role concerning the revelation of homicides and other unnatural deaths [7, 10].

At the University of Münster, medical students attend a course of 90 min in groups of six individuals participating in an external post-mortem examination. Such a practicum setting naturally implicates various shortcomings due to a restricted time frame and organisational limitations:

- The inspection of only one dead body per group can certainly only allow demonstrating a very limited spectrum of relevant forensic findings.
- Even in small groups, the students cannot perform a complete inspection without being influenced by their fellow students.
- Not all duties of the examining doctor can be realized (e.g. to assess the locality where the dead body was found, questioning an attendant person, telephone conversation with the family doctor).

– By examining only one dead body, knowledge and skills cannot be solidified by repetition.

The authors aimed at improving the medical education in legal medicine by providing virtual external post-mortem examinations. The main objective was to overcome the given barriers and restrictions of the usual course setting. The virtual cases are meant to be a supplementary approach and were not designed to substitute the real-life experience.

The e-learning programme

Fifteen virtual cases of death were generated using the Inmedea Simulator. The Inmedea Simulator is an interactive e-learning management system built around a virtual hospital that can be accessed after individual online password registration (www.inmedea-simulator.net). The access to the death cases is subject to a charge. The created cases represent various situations including death by natural cause, accident, suicide and homicide.

At the beginning the user chooses a case from a list containing the names of the deceased individuals. First information on the case is given by a phone call. The user then proceeds to the scene of death (Fig. 1) and is confronted with a first interface that allows taking elemental examination steps (recording the death and evaluating the death scene). Here the user "meets" an attendant person (detective, friend or family member of the deceased) to gain information on the death case.

At the left hand side of Fig. 1, the available tools can be discerned. With the eye tool, the place where the body was found and the dead body itself can be surveyed. The nose tool allows detecting suspicious smells at the place and above the mouth of the deceased. By using the mobile phone, the user is given the opportunity of calling the family physician in order to gain information on known medical conditions that may explain the death. The hand tool is used to take the pulse and to check the rigor mortis in all joints. The stethoscope allows to auscultate the heart and lungs. With the reflex hammer, the examiner can check for reflexes and provoke an idiomuscular contraction. The pocket lamp is used to test the pupillary response. By making use of the mirror, the expiration of breath can be checked. The pincers are used to evert the lids and to check the mucosa of the lips. The thermometer permits to take the ambient as well as the rectal temperature. By using the stimulation device, the irritability of the mimic muscles can be validated. The speech bubble tool allows to speak to the attendant persons. All the described tools work text based. The user is meant to choose the relevant tools to meet the obligations of the examiner. For example, checking for expiration of breath by using the mirror tool is not appropriate to correctly ascertain the death. At the end of this scene, the user has to decide whether to divest the corpse or to interrupt the examination in order to inform the police in case there are hints for an unnatural death.

By clicking the button "Remove clothing", the user proceeds to the next scene that shows the divested corpse. The head is additionally depicted by a magnified image because it features especially relevant regions for the examiner (Fig. 2). In this scene every body part can be examined by means of the eye tool. Findings are given by detail pictures of real dead bodies (Fig. 3) and in form of a text description. In case of certain findings (e.g. strangulation mark), the user can read the so-called expert

Fig. 1 The image shows the first scene of a death case. The post-mortem examiner has been called by the widow of the deceased and is presented a corpse that is laid out in the basement of the family house

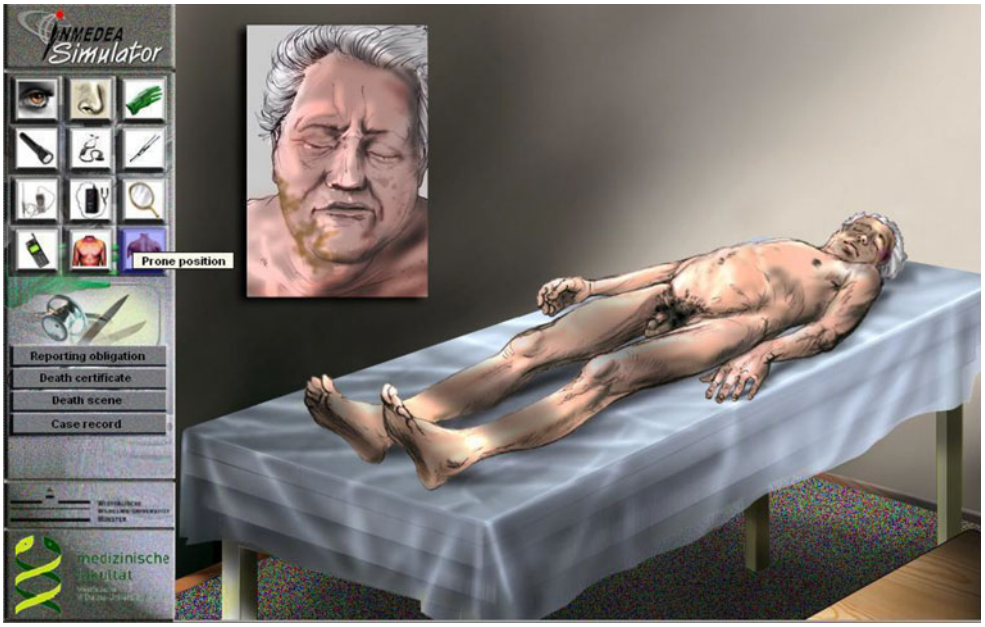

Fig. 2 After undressing the corpse, the user can examine each body part. By clicking on the downright tool button, the corpse can be turned around into prone position

commentary. The expert commentary offers interpretations of the findings and explains their forensic significance.

After having completed the examination of the corpse, the user is expected to determine if he has to meet reporting obligations. A selection menu allows reporting to the police, to the public health department or to the occupational insurance association. The programme refers to the German reporting obligations that can be different in other countries. By clicking the button "Death certificate", the user is presented a form that is meant to be completed with regard to the aspects signs of death, cause of death, manner of death and time of death.

At the end of each case, the user is given an evaluation that refers to the certification of death, forgotten examinations, unnecessary tests as well as a general result. Furthermore he is offered a summary of the case containing the expert opinion and further information (e.g. findings of a subsequent autopsy).

Evaluation

The virtual cases of death were applied for teaching purposes in the academic term of 2010/2011 at the University of Müenster. A group of 36 third year medical

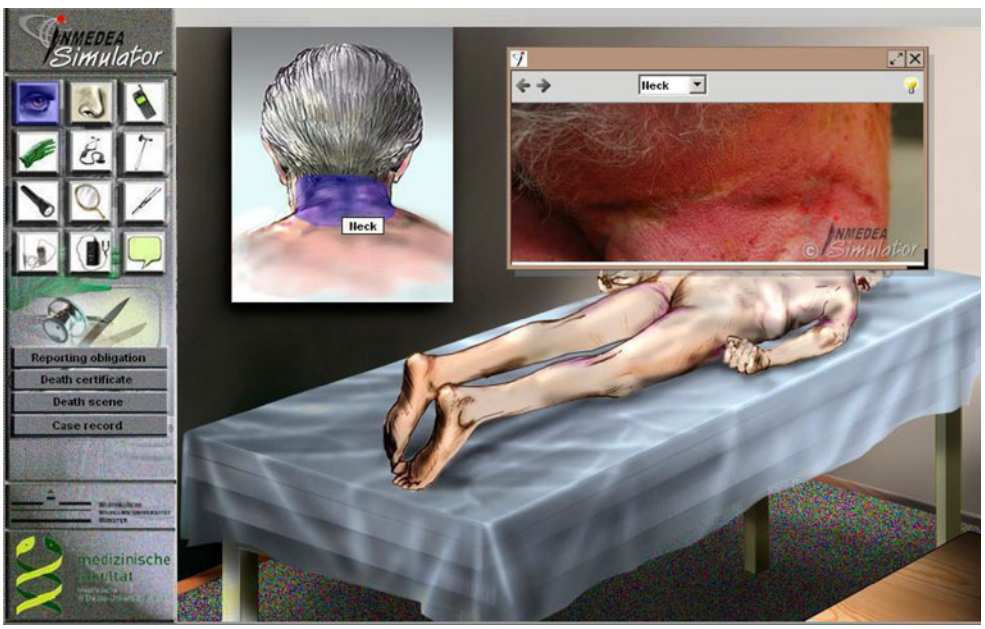

Fig. 3 The divested corpse has been turned around into prone position. For the inspection of the neck, the user is presented an original photograph showing a strangulation mark

students who had attended a series of lectures including the theoretical aspects of post-mortem examinations as well as the practical course were presented the programme in a tutorial and were asked to work on the cases from their computers at home. The students filled out a questionnaire before and after using the e-learning programme. Seven students did not return the questionnaire so that 29 students actually participated in the evaluation (6 males, 23 females).

The majority of the students had no or only minor technical difficulties in using the programme (85%). Sixty-seven percent found the programme easy to handle. Most students (93%) "liked" or "rather liked" to work with the programme, two students were ambivalent and none of the students "disliked" or "rather disliked" to work with it. The majority of students (81%) stated that using the programme had a positive learning effect referring to consolidating the knowledge about post-mortem examinations.

Before using the programme, none of the students felt "fully qualified" to perform a post-mortem examination, only 9% felt "rather qualified" and the majority chose "qualified with reservations" (54%), "rather not qualified" (26%) or "certainly not qualified" (11%). After working on the cases, students felt more confident with the idea of performing a post-mortem and 66% of the students thought to be "fully qualified" or "rather qualified". Only 8% answered "rather not qualified" or "certainly not qualified". After using the programme, the students felt more confident concerning the following aspects of a post-mortem examination: duties of the post-mortem examiner, important aspects of the forensic history taking, reporting obligations as well as recognizing hints for an unnatural death. Most students that had answered beforehand to dislike the imagination of conducting a real post-mortem examination did not change their mind after having experienced the e-learning setting.

Discussion

In forensic medicine literature, there exist numerous case descriptions of homicides that remained undetected during the external post-mortem examination but were finally revealed in the course of a subsequent autopsy [1,2,5,8,12,16]. Scientific investigations have shown that in Germany at least half of the homicides remain unrevealed. The reasons for this grey area of undetected homicides lie first of all in the misperformance of the examining doctors, more than mistakes of the public prosecutors or mistakes in the course of examinations by forensic experts in individual cases [4]. One possible measure to reduce medical misperformance in conducting an external post-mortem examination is the improvement of curricular education of medical students as well as advanced medical training and continued education of medical practitioners [4,11].

The new media as computers and the worldwide web have become important vehicles of medical education [6,13,14]. In a modern educational setting, the internet constitutes an indispensable medium for sharing information and for participating in knowledge exchange. The broad availability of wideband internet allows transmitting extended volumes of data including high-resolution pictures or video material without restraining time delays so that complex multimedia learning applications can be conveniently used via the internet. One of the most advanced applications of e-learning in medical education is the use of computerized clinical case simulations or virtual patients. These virtual case simulations have become an important component in international medical and health care education [3]. Wünschel et al. [15] reported on using orthopaedic virtual patients in the curricular teaching at the University of Tübingen that were also generated with the aid of the Inmedea Simulator. Other examples of implementing virtual patients in medical teaching at German universities are the University of Munich and the University of Heidelberg [9]. The virtual cases of death developed at the Institute of Legal Medicine in Münster are supposed to complement the traditional practicum in order to improve medical education.

As a basis for the virtual cases, the authors selected real cases that were especially appropriate with respect to didactic aspects and that moreover featured a vast spectrum of relevant forensic findings. In addition to the detailed examination of the corpse, the user is trained in skills by using the Inmedea Simulator that can merely be taught in the traditional practicum setting. For instance, the cases provide the evaluation of the place where the body was found, the user can take the history by interrogating an attendant person, he can call the family physician of the deceased and has to comply with reporting obligations. By working on the 15 virtual cases of death, the algorithm of conducting a complete external post-mortem examination can be trained including all relevant forensic aspects.

In the academic term of 2010/2011, medical students of the University of Münster worked on the virtual cases of death for the first time. The evaluation showed that the majority of students had no technical difficulties in working on the cases. The learning effect of the programme was assessed positively by most students and they predominantly declared that they felt more confident with the idea of conducting a real post-mortem after using the programme.

The evaluation also revealed that those students that were feeling uncomfortable with the idea of being obliged to examine a real corpse did not change their mind by having worked on the virtual death cases. To overcome this

reserve, it would be necessary to offer much more practical training in the traditional setting so that it would be possible for every medical student to examine several real corpses.

References

1. Al Beraiki KH, Schiwy-Bochat K-H, Rothschild MA (2011) Homicidal strangulation by victim's own artificial hair extensions. Int J Legal Med 125:459–461
2. Althaus L, Freislederer A (2009) Stichverletzungen. Missinterpretation als Ösophagusvarizenblutung. Rechtsmedizin 19:424–427
3. Begg M (2010) Curriculum: virtual patients: practical advice for clinical authors using Labyrinth. Clin Teach 7:202–205
4. Brinkmann B, Banaschak S, Bratzke H, Cremer U, Drese G, Erfurt C, Giebe W, Lang C, Lange E, Peschel O, Philipp K-P, Püschel K, Rißе M, Tutsch-Bauer E, Vock R, Du Chesne A (1997) Fehlleistungen bei der Leichenschau in der Bundesrepublik Deutschland. Arch Kriminol 199:1–12, 65–74
5. Cascini F, Tartaglione T, Oliva A, Marchetti D (2009) A case of hunting death due to an overpenetrated bullet. Int J Legal Med 123:151–153
6. Choules AP (2007) The use of elearning in medical education: a review of the current situation. Postgrad Med J 83:212–216
7. Dettmeyer R, Verhoff MA (2009) Ärztliche Leichenschau in Deutschland. Rechtsgrundlagen. Rechtsmedizin 19:391–398
8. Fracasso T, Vennemann M, Klöcker M, Bajanowski T, Brinkmann B, Pfeiffer H et al (2011) Petechial bleedings in sudden infant death. Int J Legal Med 125:205–210
9. Huwendiek S, De Leng BA, Fischer M, Ruiz JG, Ellaway R (2009) Towards a typology of virtual patients. Med Teach 31:743–748
10. Madea B, Dettmeyer R (2003) Ärztliche Leichenschau und Todesbescheinigung. Dtsch Arztebl 100:A3161–A3179
11. Madea B, Bajanowski T, Peschel O, Ritz-Timme S, Rothschild MA, Stiller D, Grass H (2010) Kontinuierliche ärztliche Fortbildung zum Thema Leichenschau. Empfehlungen der Arbeitsgemeinschaft Leichenschau der Deutschen Gesellschaft für Rechtsmedizin. Rechtsmedizin 21:51–54
12. Matschke J, Püschel K, Glatzel M (2009) Ocular pathology in shaken baby syndrome and other forms of infantile non-accidental head injury. Int J Legal Med 123:189–197
13. Ruppert B (2011) New directions in virtual environments and gaming to address obesity and diabetes: industry perspective. J Diabetes Sci Technol 5:277–281
14. Wong G, Greenhalgh T, Pawson R (2010) Internet-based medical education: a realist review of what works, for whom and in what circumstances. BMC Med Educ 10:12
15. Wünschel M, Leichtle U, Wülker N, Kluba T (2010) Using a web-based orthopaedic clinic in the curricular teaching of a German university hospital: analysis of learning effect, student usage and reception. Int J Med Inform 79:716–721
16. Zweihoff RF, Püschel K (2009) "Herzstillstand" und "natürliche Todesart". Stattdessen war es Erdrosseln. Rechtsmedizin 19:428–430