

Use of and irradiation from plain lumbar spine radiography in Switzerland

John-Paul Vader^a, Olivier Terraz^a, Laurence Perret^a, Abbas Aroua^b, Jean-François Valley^b, Bernard Burnand^a

^a Institut Universitaire de Médecine Sociale et Préventive, Lausanne, Switzerland

^b Institut Universitaire de Radiophysique Appliquée, Lausanne, Switzerland

Summary

Principles: Plain lumbar spine radiographic examination (LSRE) is frequently used in medical practice and delivers a high dose of ionising radiation. The objectives of the study were to determine the annual frequency of LSRE in Switzerland and its distribution according to practitioners' and patients' characteristics, as well as the related population dose of ionising radiation.

Methods: Data were extrapolated from a nationwide questionnaire survey on radiation exposure resulting from medical imaging in 1998, involving physicians and other healthcare providers performing radiological examinations in Switzerland.

Results: An estimated number of 273,000 LSRE are performed annually in Switzerland (39 LSRE per 1000 inhabitants per year). The collective dose to the population due to LSRE was

1130 Sv (0.16 mSv per person per year). 50–60% of these procedures were performed to confirm or rule out a diagnosis, the majority (85%) in the context of an illness.

Conclusions: LSRE is the third most frequent radiographic procedure performed and delivers the highest population dose of ionising radiation of any radiodiagnostic procedure. Efforts to reduce the frequency and the radiation dose of this procedure must be kept up, technically by optimising the equipment and radioprotection measures, and clinically by implementing evidence-based approaches to appropriate indications for this imaging technique.

Key words: spine; lumbosacral region; radiography; radiation dosage; low back pain; Switzerland

Introduction

Plain LSRE is frequently performed for a variety of indications [1]. Its (over-)use may have a not inconsiderable impact on individual and public health and on healthcare costs [2]. Considering that such tests are frequently of little clinical use [3], the fundamental question of the test's appropriateness cannot be avoided. The reply to this question can only be based on reliable data – not currently available – on the annual frequency of such procedures, the characteristics of physician performing them and the patients undergoing them.

Since the 1970s many countries – including France [4] – have carried out surveys on the frequency of examinations and the related doses. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) regularly issues a full report on the national surveys covering medical irradiation published worldwide. The latest edition, for the year 2000, provides a compilation of dosimetric values related to lumbar spine x-ray imaging in different countries [5]. In

Switzerland, periodic national surveys on the collective impact of diagnostic radiology have been performed since the late 1950s in the Radiation Physics Department of the Inselspital in Bern, the last undertaken in 1992 [6]. In 1998 a nationwide survey on radiation exposure resulting from medical x-ray imaging was conducted to obtain a new evaluation of the radiation doses delivered in Switzerland by the various radiological examinations, the frequency of these examinations and the overall impact of radiodiagnostics on the Swiss population [7, 8]. The results are fully detailed in a report covering more than 250 types of radiological examination in all types of establishments carrying out such procedures [9].

The present study aimed to determine the annual frequency of conventional LSREs performed in Switzerland and their distribution by location, age and gender of both patients and physicians, as well as by the practitioner's medical speciality and the patient's health status.

This study was supported by the Swiss Federal Office of Public Health, contract no. 316.96.0576; and the Swiss National Science Foundation, grant no. 3200B0-100794.

Methods

Within the framework of the nationwide survey on radiation exposure resulting from medical x-ray imaging cited above, 3072 physicians or healthcare providers performing radiological examinations in Switzerland (large and small hospitals, medical and dental practitioners, chiropractors and other medical institutions) were asked to complete a written questionnaire. All medical specialities were fully covered, except for general practitioners and dentists, who were sampled at a 20% and 10% rate respectively. According to the type of establishment, the survey requested detailed information (patient's age and gender, the nature of his/her disorder, the aim of the x-ray examination and severity of the health status) concerning the examinations undertaken over a two weeks' period in May 1998 (1 week for the dentists), or their 1997 or 1998 annual statistical data. The overall response rate was 60%. There was no significant difference between non-respondents and respondents as regards the age, gender or years of practice. For the present study, data related to plain LSRE were extracted and analysed. The total number of annual LSRE was calculated using the average number of

these examinations for each provider type (medical specialities and hospitals), multiplied by the total population of each provider type (corrected by the fraction not concerned with radiology), and summed for all provider types. Calculation is more detailed in the extended report [9]. The definition of a standard radiographic examination of the lumbar spine as used in this study – consisting of one lateral and one anterior-posterior view – was determined by enquiring about the current practice at a main university hospital and among a convenience sample of 10 practitioners. This definition was then submitted to eight hospital radiation services for validation. For each view, standard technical parameters (kV and mAs) commonly used in Switzerland were considered in computing the corresponding effective dose delivered to the patient during the examination.

Health care providers were stratified geographically according to the seven regions used in a model accepted by all Swiss cantons, in conformity with European regionalisation norms [10]. Information on the radiological unit and the detection system was also collected.

Results

Results indicate that an estimated 273,000 LSRE were performed in Switzerland in 1998. With a resident population of 7 million, this figure gives a rate of 39 LSRE per 1000 population per year. The annual collective dose to the population

related to this type of examination is 1130 Sv (0.16 mSv per person per year) (fig. 1). Minor regional variability was observed in the annual frequency of this examination per 1000 inhabitants, with a lower rate in eastern Switzerland (29) and higher rates in the Cantons of Zürich and Ticino (52).

50–60% of LSRE were performed to confirm or rule out a diagnosis, and 20–30% to guide the introduction or modification of treatment (fig. 2). These two objectives are predominant for all medical specialties and in all regions; only in the Canton of Zürich is there a not inconsiderable percentage (17%) of radiographic examinations performed in a context of “periodic follow-up in patients at risk”.

Patients undergoing such examinations had a mean age of 50 (SD = 19), 70% were in good health and 53% were females. The distribution of the number of examinations according to age and gender showed an increase among women over 50 (fig. 3).

The majority (85%) of LSRE were performed in the context of an illness (screening and follow-up included), and 15% following an accident. These rates are stable for different age groups, with an increasing proportion of accident-related examinations among patients over 80.

Hospitals (43%) and general practitioners (28%) accounted for the highest percentage of LSRE, followed by chiropractors (7%), rheumatologists (7%), radiologists working in private practice (7%) and orthopaedic surgeons (5%) (fig. 4). For general practitioners and small hospitals, the distribution of LSRE frequency according to the patients' age is fairly homogeneous, the rates being similar between ages 30 and 70. Orthopaedic surgeons prescribed comparatively higher examination frequencies in young patients.

Figure 1
Annual frequency and population radiation dose of selected standard x-rays in Switzerland, 1998.

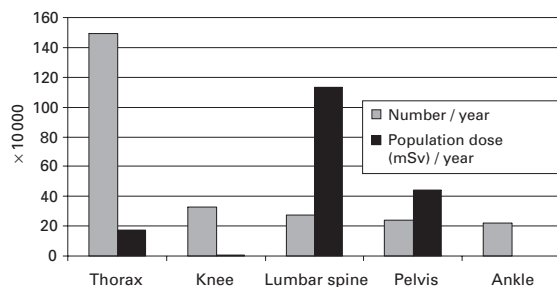


Figure 2
Proportion of lumbar spine x-rays according to the procedure objective in Switzerland, 1998 (n = 3600).

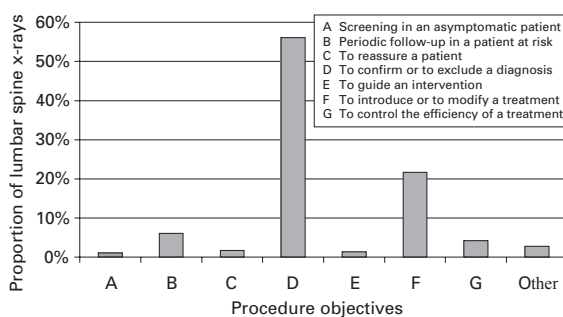


Figure 3
Gender proportions of lumbar spine x-ray by patient age category in Switzerland, 1998.

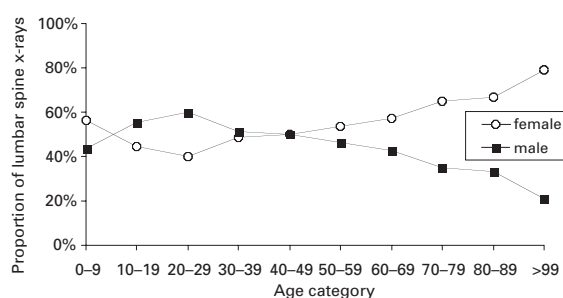
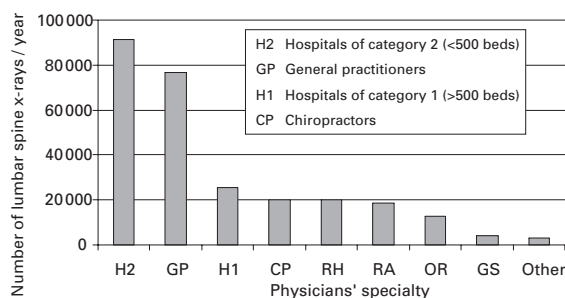


Figure 4

Annual frequency of lumbar spine x-ray by physician speciality in Switzerland, 1998 (n = 272967).



Physicians performing the procedure had a mean age of 49 (SD = 8) and average practice ex-

perience of 21 years (SD = 8); 94% were males. Physicians aged 40–60 performed the majority of the LSRE (79%), but also represent similar proportions among the total physician population. In the same way, physicians practising for 10–30 years performed the majority of the procedures (77%), corresponding to their representation among Swiss physicians. Physicians practising for a shorter time (2–10 years) performed proportionally higher numbers of such examinations. However, the variability in the frequency of use of LSRE according to physician age and years of practice was not statistically significant.

Discussion

X-ray imaging of the lumbar spine is the third most frequent radiographic procedure (6% of all procedures) after chest (33%) and knee (7%) x-rays. In terms of radiation dose to the population, it contributes 40% of the collective dose for conventional x-rays, followed by examination of the pelvis (14%) and of the abdomen (12%). To put these data in perspective it is recalled that medical exposure accounts for the highest proportion of all sources of artificial irradiation and about a fourth of the total ionising radiation dose received by the population. Compared with the UNSCEAR 2000 Report [5], the annual frequency of LSRE per 1000 population in Switzerland is below the average frequency for countries with a similar health care level (54 LSRE/1000 population/year) and more than twice the worldwide mean (16/1000 population/year). A Norwegian study conducted in 1993 showed results similar to the present study (35 LSRE/1000 population/year) [11].

Regional variation in the frequency of LSRE was observed but, beyond the simple observation, the limited information available makes it impossible to examine possible explanations for the variation.

The main objectives in undertaking LSRE were “to confirm or rule out a diagnosis” and “to guide the introduction or modification of treatment”; other reasons were rarely cited, apart from the objective “periodic follow-up in a patient at risk” in the Canton of Zurich. The presence in this region of an establishment specialising in spinal disorders may explain this finding, but since the data were anonymous, this cannot be confirmed.

Variability in the frequency of LSRE according to patient age shows a higher proportion in males aged 20–50 (a population more prone to low back pain), and there is a higher proportion in women over 50 (a population more prone to osteoporosis-related problems and with a greater life expectancy). The mean age of 50 of the patients undergoing the examination is similar to that in other published studies (47–54) [12–14].

The prescription of LSRE is predominantly (85%) motivated by illness (screening and follow-

up included), a proportion largely in agreement with the literature [15, 16]. Although we do not have more precise data on the nature of the illness, we can reasonably assume, in the light of the literature [12], that low back pain represents the main cause motivating LSRE. In the United States, low back pain is the second most frequent reason for consulting, all physicians included, and the most frequent reason for consulting orthopaedists [15, 17, 18]. Prevalence is important: 80–90% of all adults have suffered from low back pain once in their lives [15]. In Switzerland, data from the 1989 PROMES survey of the Swiss population reported that 10% of those interviewed had suffered severe low back pain in the previous 4 weeks [19]. Moreover, bone and musculo-skeletal problems are the most frequent grounds for disability pensions in the Swiss male population, among whom back disorders occupy the highest rank [20].

Nearly three-quarters of these dose-intensive radiodiagnostic procedures were performed in healthy people, a finding which underlines the need for constant measurement of the procedure's risk/benefit ratio, and serious discussion of its indication.

Patient age distribution within the physicians' speciality shows that orthopaedic surgeons perform a higher proportion of LSRE in young patients compared with the other specialities; this is probably due to the fact that they are more concerned in their practice with care of patients suffering from back disorders related to growth and congenital malformations. Not counting the procedures carried out in hospitals, the rate of LSRE according to physician speciality shows a clear prevalence of examinations performed by general practitioners (internists included); low back pain is their second most frequent reason for consultation, after the common cold [15, 21].

Some limitations of this study should be mentioned. Information on the examinations performed was, of necessity, very rudimentary. There were, for example, only raw data on the indication for the examination, and no details concerning the

final diagnosis. Nor can we be sure that the two weeks' period chosen for the study was representative of the whole year. Nevertheless, given the fact that low back pain is the main disorder motivating lumbar spine radiography, and that we can reasonably assume there is no significant seasonal variability in this indication, we do not feel these limitations invalidate the results of our study. Finally, the method of extrapolating the total annual number of x-ray examinations provides only an estimation, not a true incidence figure. It is, however, the best data we have at present on the annual use of lumbar spine radiography. In addition, possible minor inaccuracies in the estimation certainly do not invalidate the observation that plain LSREs produce by far the highest annual population dose of any radiodiagnostic procedure (1130 Sv), surpassing even CT of the lumbar spine with its estimated annual frequency of 37,000 and total annual population dose of 350 Sv.

Although the main results compare well with the average data for other countries of similar health care level, this does not mean the observed usage rate is appropriate. Efforts to reduce the frequency and the radiation dose of this procedure must be kept up, technically by optimising the equipment and radioprotection measures, and clinically by implementing evidence-based ap-

proaches to enhance appropriate use of the procedure. The question of appropriateness of lumbar x-ray imaging should be raised and could be addressed by the introduction, dissemination and evaluation of evidence-based practice guidelines, or similar approaches, for its use [22, 23]. Supported by effective implementation strategies, the frequency of such examinations and the related collective dose could be reduced without compromising quality of care. This is more than ever important considering the constant growth of health-care demand and access, as well as the related increase in the cost and potential adverse effects of medical care.

Contributors: OT and LP participated in the analyses and the literature review, and were primarily responsible for drafting the article. JPV, AA and JFV were responsible for management and running the study. JPV, AA and BB contributed to the final version of the article. JPV is the guarantor.

Correspondence:

*Dr. John-Paul Vader, MD, MPH, Privat-docent
University of Lausanne
Institute of Social & Preventive Medicine
Rue du Bugnon 17
CH-1005 Lausanne
E-Mail: John-Paul.Vader@hospvd.ch*

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