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Original Article

Diagnostic errors in computed tomography outsourcing: Analysis of a single center

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Abstract

Aim: The reporting of medical imaging with outsourcing is used by many hospitals in Turkey. The aim of this study was to evaluate outsourced computed tomography (CT) reports and determine any errors made.

Material and Methods: The study was planned with a prospective design. The reports of the CT tests taken during 2017 by an outsourced company of 35 randomly selected patients were compared. In the comparison, findings which could lead to a change in diagnosis and treatment were labelled as "significant" and findings which would not lead to a change in diagnosis and treatment were labelled as "non-significant". Findings reported in the study comparison but not mentioned or written incorrectly in the outsourced company report were classified as "absence" and any finding that was written but not present was labelled as "extra".

Results: The study included the examsimages and reports of 35 patients, comprising 18 (51.4%) males and 17 (48.6%) females with a mean age of 49.37± 23.66 years. A major error was found in 27 (77%) cases. No statistically significant difference was determined in the significant, non-significant, absent and extra data according to patient age (p>0.05).

Conclusion: There should be an implementation of regulations for clinicians to be able to re-use the diagnostic algorithm. Residential employment of radiologists should be encouraged rather than outsourcing.

Keywords: Radiology; outsourcing; teleradiology; diagnostic errors; misdiagnosis.

INTRODUCTION

Outsourcing has been applied for many years by Ministry of Health and university hospitals for several non-medical services such as catering and cleaning but in the last 10 years there has been an increase in outsourcing for laboratory tests and medical imaging in addition to medical supplies and equipment (1,2,3) There are many factors in this increase. One of the most important factors is the increasing number of presentations at hospitals in Turkey (4). The high demand for computed tomography (CT) and magnetic resonance imaging (MRI) combined with the insufficient number of radiology specialists causes delays in the reporting process.

To overcome this delay, the use of outsourcing in the reporting of radiological tests seems to provide a solution and has become increasingly widespread. The aim of this study was to evaluate outsourced CT reports and determine any errors made.

MATERIAL and METHODS

This study was approved by Erzincan Binali Yildirim University Ethics Committee with 14/02 numbered decision, and study permission were obtained from the hospital administration and provincial health directorate. In this prospective study, evaluation was made of the CT tests of 35 randomly selected patients that were taken at two different hospitals in the province of Erzincan between 1 October and 30 October 2017. The CT tests were reported by 2 independent radiology specialists then a final report was obtained by consensus. These reports were compared with the reports written by an outsourcing company. During the comparison, findings which could lead to a change in diagnosis and treatment, whether related or not to the region where the image was taken, were labelled as "significant" and findings which would not lead to a change in diagnosis and treatment were labelled as "non-significant". Findings reported in the study comparison which were not mentioned or, despite

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the visualization of pathological findings, were reported incorrectly in the outsourced company report were classified as "absence" and any finding that was written but not present was labelled as "extra".

Statistical analyses of the data obtained in the study were made using SPSS for Windows vn 20.0 (SPSS Inc., Chicago, IL, USA). Descriptive findings were reported as number and percentage for categorical variables and as mean±standard deviation (minimum- maximum) values for continuous variables. Conformity of continuous variables to normal distribution was assessed with the Kolmogorov-Smirnov test and the Shapiro-Wilk test. Continuous variables conforming to normal distribution were compared with the parametric Student's t-test. A value of $p < 0.05$ was accepted as statistically significant.

RESULTS

The study included the exams and reports of 35 patients, comprising 18 (51.4%) males and 17 (48.6%) females with a mean age of 49.37± 23.66 years (median, 44.00 years; range, 13-88 years).

The distribution of the tests was 28.6% (n=10) thorax, 28.6% (n=10) full abdomen (upper and lower) and 2.9% (n=1) angiography (Table 1). In 1 (2.2%) case, a significant error was absent and a non-significant error was extra as the test had been reported as cervical CT by the outsourcing firm although the test was of neck CT. That case was excluded from the study. In the other 34 (97.2%) reports, at least one significant or non-significant, absent or extra finding was determined. While the study readers reported a total of 194 pathologies, 67 pathologies were reported by the outsourcing company. In one patient, the presence of a liver cyst of millimetric dimensions mentioned in the outsourcing company report was not determined as absent by the study reporters. In the reports written by the observers, there was inconsistency in 2 separate tests on the subject of non-significant absence. Different opinions were reported in respect of concha hypertrophy in the PNS test and of the presence of cerebellar atrophy in the brain CT examination. A consensus report was obtained for these two different opinions.

There were non-significant absences in 31 (91.2%) reports and no non-significant absences in 3 (8.8%). The non-significant absences were determined at the rates of 1 in 11 (32.4%) reports, 2 in 11 (32.4%), 3 in 4 (11.8%), 4 in 3 (8.8%), 5 in 1 (2.9%) and 7 in 1 (2.9%) (Table 2). Vascular calcification was not reported in 9 (14.29%) reports, findings from the lung parenchyma included in the abdomen CT in 8 (12.7%) and bone findings in 7 (11.11%) (Table 3).

Significant absences were not determined in 26.5% of the tests and were determined at the rates of 1 in 12 (35.3%) reports, 2 in 5 (14.7%), 3 in 6 (17.6%), 4 in 1 (2.9%) and 7 in 1 (2.9%) (Table 4). It was determined that lymphadenopathy was not reported in 3 (7.69%) reports, pulmonary metastasis in 2 (5.13%) (Figure 1) and findings of emphysema in 2 (5.13%) (Table 5).

Table 1. Distribution of the tests applied

	n	%
Thorax	10	28.6
Upper and Lower Abdomen	10	28.6
Brain	7	20.0
Neck	4	11.4
PNS	3	8.6
Angiography	1	2.9
Total	35	100.0

Table 2. The numbers of non-significant absences

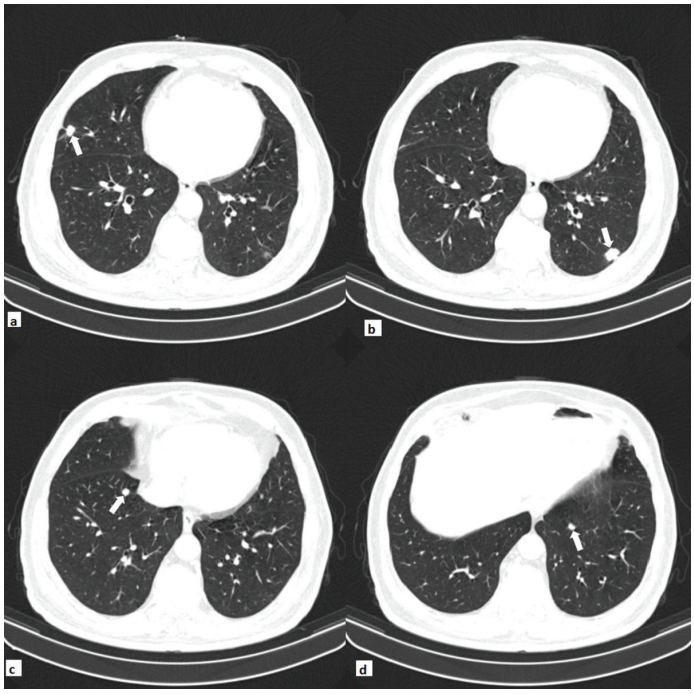
Number of non-significant absences	n	%
0	3	8.8
1	11	32.4
2	11	32.4
3	4	11.8
4	3	8.8
5	1	2.9
7	1	2.9
Total	34	100.0

Table 3. The distribution of non-significant absences

Distribution of absences	n	%
No non-significant absence	5	7.25%
Vascular calcification	9	13.04%
Left shift Lungs not mentioned on abdomen CT	8	11.59%
Bone not mentioned	7	10.15%
Abdomen not mentioned on thorax CT	6	8.70%
Extra-nodular finding in the lung	4	5.80%
Nodule in the lung	3	4.35%
Inguinal hernia	3	4.35%
Sclerosis in the bone	2	2.90%
Cyst in the liver	2	2.90%
Other	20	28.99%
Total	69	100.00%

Table 4. The numbers of significant absences

Number of significant absences	n	%
0	9	26.5
1	12	35.3
2	5	14.7
3	6	17.6
4	1	2.9
7	1	2.9
Total	34	100.0



Figures 1a,b,c,d. On contrast abdomen CT, the report written by the outsourcing company did not mention a total of 4 spiculated, contoured nodular lesions (white arrow), as 2 on the right side (a,b) and 2 on the left side (c,d) of the inferior lobe basal segments of both lungs on the slices passing the thorax level

Table 5. The distribution of significant absences

	n	%
No significant absence	19	37.25%
Lymphadenopathy	3	5.88%
Pulmonary metastasis	2	3.92%
Left shift emphysema	2	3.92%
Concha bullosa on paranasal sinus CT	2	3.92%
Consolidation	2	3.92%
Catheter not identified in the report	2	3.92%
Other	19	37.25%
Total	51	100.00%

As the result of the examination, there were determined not to be any non-significant extra data in 29 (85.3%) reports and 1 non-significant extra finding in 5 (14.7%) reports. No significant extra findings were determined in 32 (94.1%) reports and a significant extra finding was determined in 2 (5.9%) reports. The distributions of the significant and non-significant extra data are shown in Table 6.

At least 1 significant absence or extra finding was determined in 27 (77%) of the total patient reports. No statistically significant difference was determined between the significant and non-significant absent and extra findings when compared in respect of age (p>0.05).

Table 6. The distribution of significant and non-significant extras

Non-significant extra	**n**	**%**
None	29	85.71
Elevated diaphragm	1	2.85
Concha hypertrophy	1	2.85
Infiltrative changes in the rectum	1	2.85
Cyst in the right kidney	1	2.85
Cerebral Atrophy	1	2.85
Total	34	100.00
Significant extra		
None	32	94.28
Emphysema	1	2.85
Ischaemic gliotic	1	2.85
Total	34	100.00

DISCUSSION

The number of hospital presentations in Turkey is increasing significantly year on year. From 2002 to 2016, this increase was 3.6-fold and reached 447.648.830 (4). According to the 2016 statistics, Turkey is ranked last in international comparisons with a total number of 181 physicians per 100.000 people (Organisation for Economic Co-operation and Development (OECD) mean 344). However, in the international comparison of number of physicians per presentation, at 8.6, Turkey is above the OECD average of 6.9 (5).

The 2016 statistical data reported a total of 1152 CT machines and 836 MR machines in Turkey (4). When the number of CT devices per 1.000.000 people was compared internationally in treatment centres for in-patients, these figures are far below the OECD average of 26.8. The mean of 14.4 in Turkey gave a ranking of 25 out of 30 countries. The number of MR devices was below the OECD average of 16.2 in the international comparison, with an average of 10 ranking Turkey 19 out of 29 countries (5).

In the international comparison of the number of CT exams per 1000 people in treatment centres for in-patients, Turkey was ranked 7th with 188, which was above the OECD average of 147. A more dramatic difference was seen in the number of MR exams, with Turkey ranking first with 157, more than double the OECD average of 67. Thus, while the number of CT and MR devices remains below the OECD average, the number of exams taken per CT and MR device in in-patient treatment centres is above the OECD average. The OECD average number of exams per CT device is 6,890 and this number in Turkey is approximately double at 12.993 giving Turkey a ranking of second. With the number of 14.992 exams per MR device, Turkey is ranked first.

As a result of these statistical data, it can be seen that in Turkey there are fewer physicians and fewer imaging devices providing a service for a greater number of patients compared to other OECD countries. In addition to the insufficient number of doctors, as there is a high number of patient presentations, the time that each

clinician spends with a patient is reduced and this results in an abandoment of algorithms such as inspection, auscultation, palpation and percussion that are required in a normal clinical examination. Thus, diagnosis is made using laboratory and imaging methods without examining the patient in detail. Consequently, extreme increases in the number of CT and MR exams taken are inevitable. Deficiencies in both the number of machines and the specialist doctors who will write the reports are other important problems.

Outsourcing has been applied for many years by Ministry of Health and university hospitals for several non-medical services such as catering and cleaning but in the last 10 years there has been an increase in outsourcing for laboratory tests and medical imaging in addition to medical supplies and equipment (6). Moreover, as the Ministry of Health has applied medical and non-medical outsourcing with the consideration of significant cost savings (1,2), this method is now applied by many more hospitals. Consequently, the demand for outsourcing has increased. According to data obtained from the internet site, www.ilan.gov.tr tenders were put out for medical imaging reporting for over two million exams in 2017. These figures constitute a significant proportion of the techniques of annual CT and MR tests. With these data, the importance of this study can be considered to be further increased.

Error rates in radiology are lower than in other clinics, with an average varying between 3%-5% (7). In other clinical sciences, this rate can reach 15%. (8).

In the current study, at least one error was found in 34 (97.2%) of 35 reports, and in 1 patient, although the test was of neck imaging, cervical was written on the report. At least one significant error was found in 27 (77%) of the total patients. From a questionnaire applied by the Turkish Radiology Association, an analysis was made of the intensity of radiological tests, problems arising from this intensity of testing and recommended solutions, and the report published in January 2018 stated that the rate of radiologists reporting on 300 or more tests was 1% in the public sector and outsourcing was applied at 7% (9).

In a study by Altman (10), it was reported that the most important disadvantage of outsourcing is that there is a breakdown in good communications between the radiologist and clinicians or other healthcare personnel. Systemic errors, including errors occurring because of not establishing proper communication between the clinician and radiologists, constitute approximately 65% of diagnostic errors (10). Not establishing good communication between the clinician and radiologist in the outsourcing system is a probable reason for errors.

As reports from outsourcing companies cannot be read with confidence, clinicians have become accustomed to examining the images themselves rather than reading the report. Thus, the clinician feels obliged to confirm a service that has been paid for. The time taken for this confirmation is made by restricting the time required for anamnesis, examination or treatment of the patient.

In one patient of the current study, many lesions which were suspected of being malignant observed in the pulmonary parenchyma of the full abdomen CT were not reported at all by the outsourcing company (Figure 1). An abdominal resorption fluid was not reported by the outsourcing company in another patient (Figure 2).

Figure 2. On non-contrast abdomen CT, the report written by the outsourcing company did not mention perihepatic (white arrow) and perisplenic (black arrow) fluid

Incorrect or delayed diagnosis is inevitable as a result of incorrect reporting. This has a direct effect on the morbidity and mortality of the patient. Evaluating outsourcing from an economic perspective, Reinus (11), emphasised the necessity for certain absolute standards for cost-effectiveness. The increased financial burden as a result of increasing error rates has not been calculated in any of the studies that have shown reduced costs in medical imaging using the outsourcing model with the tender method and this factor has been ignored (2,3,12).

There are many firms providing reporting services. The main limitation of this study is that the reports included in the study were from a single firm. Another limitation of the study was the low number of cases and this could be overcome with the planning of future similar studies as multi-centre studies in different hospitals with different outsourcing firms and the inclusion of MR tests to provide more robust data.

CONCLUSION

As a solution, it is necessary to make arrangements for clinicians to re-use the diagnostic algorithm. Residential employment of radiologists should be encouraged rather than outsourcing.

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