Structured Reports for Communicating with Hepatobiliary Surgeons

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Introduction

Clear and effective communication of imaging findings should be the main goal of an interpreting radiologist. Most physicians rely on radiological reports to plan patient management and treatment, and unclear communication may hinder appropriate treatment, even when the diagnosis is correct.

Traditional nonstructured reports are composed of free narrative text, with variable information, terminology, and recommendations [1]. Such free-text reports may be difficult to interpret for the referring physicians, and often lead to a second radiological consultation for clarification [1]. Moreover, free-text reports may lack clinically relevant information essential for surgical planning.

In hepatobiliary surgery, a major objective for the abdominal radiologist interpreting a liver study is to determine the eligibility for surgery of patients with malignant hepatic lesions. Reporting liver imaging is not an easy task. Reports are challenging given the possible presence of underlying chronic liver disease with multiple hepatic findings, coexistence of benign and malignant lesions, sequela of locoregional treatments, and the complex appearance of images. Moreover, radiologists are required to summarize the main findings according to several guidelines systems, such as the Liver Imaging Reporting and Data System (LI-RADS) for assessing the probability that a lesion is a hepatocellular carcinoma (HCC) in high-risk patients [2], or RECIST criteria to evaluate the treatment response in solid neoplasm after chemotherapy [3]. Given this complexity, it is easy to omit relevant findings requested by hepatobiliary surgeons, such as the absence of vascular invasion in a patient with multiple hepatic lesions.

Prior literature and scientific societies have introduced structured reports for many clinical circumstances [4, 5]. Despite these advances, communicating imaging findings to hepatobiliary surgeons remains challenging for radiologists.

The purpose of this article is to illustrate the main benefits, challenges, and caveats of structured reporting, with particular attention to preoperative hepatobiliary imaging evaluation in patients with malignant hepatic lesions in cirrhotic and non-cirrhotic livers.

The new era of structured reporting

The ultimate goal of structured reporting is to impact clinical care by improving the communication of imaging findings to referring physicians. In recent years, growing evidence has supported the use of structured reports in clinical practice to achieve higher quality and more reproducible communication with clinicians [6–9].

Structured reports decrease the incidence of syntactic and grammatical errors, which are encountered in 22–33% of conventional dictations [10, 11]. A structured template drastically reduces the use of subjective terms for communicating impressions, preventing interpretation ambiguities [12, 13]. Terms such as "consistent with", "compatible with", or "may represent" have significantly different interpretations among radiologists and clinicians regarding the intended level of certainty for imaging diagnosis [14]. In liver imaging, Corwin et al. [15] reported that up to sixteen different terms were adopted in nonstructured reports to describe the same lesions at risk of being HCC, which may have been more simply classified as LR-4 or LR-5 according to the LI-RADS lexicon [2]. Several radiologists also report significantly improved workflow efficiency with reduced dictation time when using standardized reporting [16, 17]. In academic centers, the implementation of structured reports has been proposed for residents training [18, 19]. Lastly, structured reports facilitate better assessability for automated retrospective data analysis for research purposes.

Several studies have shown that, compared with free-text reports, structured templates result in higher satisfaction and improved clarity for referring physicians [7, 20–24]. The greatest improvements were in readability, easier interpretation, increased detail, adherence with current practical guidelines [7, 25–27] and, most importantly, higher rates of management recommendations suggested by radiologists [7, 20].

There is no unique template for a structured report. A template should be designed together with the referring physicians to address a distinct disease and focus on answering specific clinical questions [13]. It also needs to change over time, with constant updates taking into account current evidence and guidelines as well as feedback from interpreting radiologists and referring physicians [23, 28–30].

Most templates are organized in paragraphs including clinical history, technique, comparison, findings and impressions. The "techniques" paragraph should briefly document the main phases/sequences acquired as well as the administration of intravenous contrast agent and the presence of any adverse or allergic reaction. Comparison with prior imaging studies evaluating the target organs should always be reported. The "findings" section is usually organized with subheadings relating to the specific relevant lesions or various imaged organs or anatomical structures [1]. Each subheading may be followed by narrative text or by a standardized text with checkboxes containing options for describing specific findings [16]. Impressions should be concise, including answers to the clinical questions, unexpected relevant findings as well as suggestions for further evaluation, follow-ups, or treatment options according to specific guidelines [16]. Differential diagnosis may be provided if the described observations have uncertain interpretation.

The caveat is to adopt structured reporting only when appropriate according to the clinical context. The systematic use of structured reporting should not prevent the radiologist to switch or customize the template with free-text in more complex or unusual cases, where the standard template is insufficient for describing all the relevant information [8]. Templates should simplify and improve the radiology workflow, so rigid and inefficient reports may need to be revised or abandoned if there are no advantages in specific clinical scenarios.

In hepatobiliary imaging few authors have assessed the effects of structured reporting for the assessment of hepatic lesions [12, 15, 31]. At the University of Palermo, we have introduced structured reports for several clinical applications in abdominal imaging, with promising feedback for the screening and diagnosis of HCC, and pre-operative staging of colorectal liver metastasis and pancreatic ductal adenocarcinoma.

Structured reporting for cirrhotic patients

In cirrhotic patients, hepatocellular carcinoma is the most common liver malignancy, and the leading cause of mortality in compensated cirrhosis [32]. According to the European Association for the Study of the Liver (EASL) and the American Association for the Study of Liver Disease (AASLD), surgical resection is recommended for single HCC, even large lesions (diameter greater than 2 cm), when hepatic function is preserved [33–35].

Structured reports for cirrhosis must clearly communicate the imaging diagnosis to the hepatobiliary surgeons (Fig. 1). Each suspicious lesion should be described individually, including location according to Couinaud segments, maximum diameter with series and image number in which the lesion is measured, the presence of typical major imaging features of HCC (i.e. arterial phase hyperenhancement, washout, peripheral capsule and growth over time), and significant changes from prior exams [35]. When using LI-RADS for the non-invasive diagnosis of HCC, the final categorization should be reported individually for each untreated observation suspicious of malignancy [2]. The spread of LI-RADS templates has been supported by the American College of Radiology website, with sample reports and guidance for concise reporting according to LI-RADS recommendations [36].

One major task for the radiologist is to communicate to hepatobiliary surgeons the presence of macroscopic vascular invasion of HCC or other non-HCC malignancies, which remains one of the main contraindications for surgery [33, 35]. Findings suggestive of tumor in a vein, such as enhancing thrombus, vessel expansion, and restricted diffusion on MRI, must be scrutinized and described in each lesion [37].

In cirrhotic patients, eligibility for surgery depends not only on tumor burden but also on the stage of the chronic liver disease [34]. A structured report should include a detailed description of liver morphology, presence of oesophageal and/or gastric varices, reanalyzed paraumbilical vein, splenomegaly, and ascites [35]. When a major resection is planned, the report should include quantification of future liver remnant (FLR) to ensure that it is sufficient [35].

Radiological reports are crucial to determine organ allocation in patients referred for liver transplant. Eligibility for orthotropic liver transplant is based on the number and maximum diameter of lesions diagnosed as definitive HCC. Templates in candidates for orthotopic liver transplant may be integrated with the OPTN (Organ Procurement and Transplantation Network) classification, which assigns exception points in the United States for transplant for lesions that are unequivocally diagnosed as HCC using imaging [38]. Particularly the OPTN encourages a

structured summary at the end of the report, describing number, size, location, and classification of lesions meeting the criteria for HCC [38].

Some recent studies have investigated the relevance of structured reporting in cirrhosis [12, 15, 31, 39, 40]. Flusberg et al. [12] demonstrated that structured templates using LI-RADS for diagnosis of HCC were significantly associated with more "comprehensive and consistent" reporting of LI-RADS category and description of major features of HCC, as well as size and location of the observations. Poullos et al. [31] analyzed the performance of structured reports in patients with HCC eligible for orthotopic liver transplant, finding significantly improved communication of imaging findings, OPTN class, and eligibility for transplant.

Structured reporting for non-cirrhotic patients

In a non-cirrhotic liver, the most common malignant lesions are metastases, especially of colorectal origin. Hepatic metastases are the primary cause of mortality in patients with other abdominal neoplasms [35]. Although HCC may also arise in patients without evident risk factors for chronic liver disease, its diagnosis usually requires a histopathological confirmation. Another primary hepatic malignancy commonly occurring in non-cirrhotic patients is intra-hepatic mass-forming cholangiocarcinoma. Surgical resection of tumors limited to the liver remains the only potential curative treatment to provide longer survival times [41]. Communicating imaging findings to hepatobiliary surgeons should take into account possible surgical treatments [42–44].

Clinical history: [age]-year-old [female/male] with cirrhosis.

Locoregional treatment: [none – TACE/RFTA in segment…].

Technique: MRI of the liver was performed with the following sequences [sequence type]. Images were obtained prior and following the uneventful administration of [volume] ml of [contrast type].

Comparison: MRI dated [MM/DD/YY].

Findings

Liver morphology: [Cirrhosis].

Lesion #1: In the hepatic segment [segment number] there is a [dimension] cm observation (series [number], image [number]) showing [nonrim arterial phase hyperenhancement] and [washout – enhancing capsule] on portal venous and delayed phases. Threshold growth is [present – absent]. The lesion is classifiable as LR-[classification].

Lesion #2: In the hepatic segment [segment number] there is a [dimension] cm observation (series [number], image [number]) showing [nonrim arterial phase hyperenhancement] and [washout – enhancing capsule] on portal venous and delayed phases. Threshold growth is [present – absent]. The lesion is classifiable as LR-[classification].

Lesion #3: In the hepatic segment [segment number] there is a [dimension] cm observation (series [number], image [number]) showing [nonrim arterial phase hyperenhancement] and [washout – enhancing capsule] on portal venous and delayed phases. Threshold growth is [present – absent]. The lesion is classifiable as LR-[classification].

Hepatic vessels: [patency – nontumoral thrombosis – tumor in vein] of [portal vein – hepatic vein].

Anatomical variants of hepatic vasculature: [none – present (describe)].

Bile duct: [non dilated – dilated].

Extra-hepatic findings: [none, splenomegaly, varices, ascites].

Other organs: [describe other findings].

Impression:

- Lesion #1: [dimension] cm observation in segment [number], classifiable as LR-[LI-RADS classification].
- Lesion #2: [dimension] cm observation in segment [number], classifiable as LR-[LI-RADS classification].
- Lesion #3: [dimension] cm observation in segment [number], classifiable as LR-[LI-RADS classification].
- [patent – nontumoral thrombosis – tumor in vein] of [portal vein – hepatic vein].

1 Example of a structured report template for HCC screening with MRI in cirrhotic patients.

At Palermo, we have adopted structured reports for preoperative hepatic staging of patients with colorectal liver metastasis imaged with MRI (Fig. 2), with significant improvements in communication with hepatobiliary surgeons. The template should include all the surgically relevant anatomical factors needed to plan the resection, and evaluate extra-hepatic disease, background liver parenchyma, and changes after neoadjuvant chemotherapy [45].

Each report should accurately describe the size and number of lesions, the number of involved and uninvolved segments, as well as the relationship and degree of tumor contact with arterial and venous hepatic vessels [35, 45, 46]. Vascular invasion of the main portal vein or hepatic artery often prevents tumor eradication [46]. Ideally, the report should also provide a clear description of anatomical biliary and vascular variants that may significantly influence the resectability or increase the risk of iatrogenic injuries during resection.

The presence of extra-hepatic disease is another significant contraindication for liver resection. Extra-hepatic lesions suspicious of malignancy should be always carefully described in the structured report in both findings and impressions [45]. The size and location of enlarged suspicious abdominal lymph nodes should also be reported.

Up to 60% of patients receive neoadjuvant chemotherapy before resection of hepatic metastases [47], so the report should include comparison with prior exam, with description of size changes, and evidence of treatment response or stability of the disease [3]. Olthof et al. [48] demonstrated that structured reporting for patients receiving neoadjuvant treatment improves report quality

Clinical history: [age]-year-old [female/male] with colorectal adenocarcinoma.

Chemotherapy: [none – number cycles of …].

Locoregional treatment: [none – resection of segment … – left/right hepatectomy].

Technique: MRI of the liver was performed with the following sequences [sequence type]. Images were obtained prior and following the uneventful administration of [volume] ml of [contrast type].

Comparison: MRI dated [MM/DD/YY].

Findings

Liver morphology: [Normal – Dysmorphic liver - Cirrhosis].

Lesion #1: In the hepatic segment [segment number] there is a [dimension] cm lesion (series [number], image [number]) showing [hyperenhancement – rim enhancement – no enhancement] on hepatic arterial phase [with – without] washout on portal venous phase and hypointensity on hepatobiliary phase. The lesion is [increased in size – stable – decreased in size] compared to prior exam, previously measuring [dimension] cm. The lesion is [probably metastasis – indeterminate – probably benign].

Lesion #2: In the hepatic segment [segment number] there is a [dimension] cm lesion (series [number], image [number]) showing [hyperenhancement – rim enhancement – no enhancement] on hepatic arterial phase [with – without] washout on portal venous phase and hypointensity on hepatobiliary phase. The lesion is [increased in size – stable – decreased in size] compared to prior exam, previously measuring [dimension] cm. The lesion is [probably metastasis – indeterminate – probably benign].

Lesion #3: In the hepatic segment [segment number] there is a [dimension] cm lesion (series [number], image [number]) showing [hyperenhancement – rim enhancement - no enhancement] on hepatic arterial phase [with – without] washout on portal venous phase and hypointensity on hepatobiliary phase. The lesion is [increased in size – stable – decreased in size] compared to prior exam, previously measuring [dimension] cm. The lesion is [probably metastasis – indeterminate – probably benign].

Hepatic vessels: [patency – nontumoral thrombosis – tumor in vein] of [portal vein – hepatic vein].

Anatomical variants: [none – present (describe)].

Bile duct: [non dilated – dilated].

Other organs: [describe other findings].

Impression:

- Lesion #1: [dimension] cm lesion in segment [number], [new – increased in size – stable – decreased in size] compared to prior exam.
- Lesion #2: [dimension] cm lesion in segment [number], [new – increased in size – stable – decreased in size] compared to prior exam.
- Lesion #3: [dimension] cm lesion in segment [number], [new – increased in size – stable – decreased in size] compared to prior exam.
- [patent – nontumoral thrombosis – tumor in vein] of [portal vein – hepatic vein].

2 Example of a structured report template for MRI acquired in the preoperative evaluation of non-cirrhotic patients with colorectal liver metastasis.

and adherence to RECIST guidelines for assessing treatment response. Attention should be paid to possible liver confounders caused by chemotherapy-induced hepatotoxicity. In particular, oxaliplatin treatment of colorectal metastasis has been associated with sinusoidal obstruction syndrome [49] and in some cases with the appearance of focal nodular hyperplasia-like nodules [50].

Although structured reporting is recommended by several societies for preoperative evaluation of focal liver lesions in non-cirrhotic liver, there is a lack of evidence in the radiological literature supporting its value.

Conclusions

We have illustrated the major strengths and limitations of structured reporting in liver imaging, focusing on communicating imaging findings to hepatobiliary surgeons for treatment of malignant liver lesions in cirrhotic and non-cirrhotic patients. Implementation of structured report templates may improve the quality and completeness of reports, focusing them on relevant clinical questions that are crucial for surgical planning.

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