the training samples; selecting a subset of quantified parameters, the subset including one or more parameters of the selected histopathological feature; constructing a model for assessing the selected histopathological feature from the subset of quantified parameters such that each training sample has a corresponding value associated with the selected histopathological feature, wherein a set of continuous values is generated by the model based on the plurality of training samples; and validating the constructed model using the validation samples.

[0008] There is also disclosed a method for evaluating efficacy of a therapeutic intervention, the method comprising: determining, from a first liver biopsy sample of a subject before the therapeutic intervention, a first degree of NASH using the method as described above; determining, from a second liver biopsy sample of the subject after the therapeutic intervention, a second degree of NASH using the method as described above; and comparing the first degree and second degree to determine efficacy of the therapeutic intervention.

[0009] Another aspect of the system for assessing nonalcoholic steatohepatitis (NASH) in a liver biopsy sample, the system comprising a processor; and a computer-readable memory coupled to the processor. The memory has instructions stored thereon that are executable by the processor to: receive image data of the liver biopsy sample indicative of histopathological features, the histopathological features comprising features selected from the group consisting of fibrosis, inflammation, ballooning and steatosis; apply a trained model for assessing a selected histopathological feature to the extracted image data to determine an index associated with said histopathological feature; and determine a degree of NASH based on the determined index. The trained model for assessing the selected histopathological feature comprises: a quantification module for quantifying parameters of the histopathological features from image data of each of a plurality of training samples, each training sample comprising a graded liver biopsy sample; a selection module for selecting a subset of quantified parameters, the subset including one or more parameters of the selected histopathological feature; a construction module for constructing a model for assessing the selected histopathological feature from the subset of quantified parameters such that each training sample has a corresponding value associated with the selected histopathological feature, wherein a set of continuous values is generated by the model based on the plurality of training samples; and a validation module for validating the constructed model using a plurality of validation samples, each validation sample comprising a graded liver biopsy sample.

CLAIMS

1. A method for assessing nonalcoholic steatohepatitis (NASH) in a liver biopsy sample, the method comprising:

extracting, from the liver biopsy sample, image data indicative of histopathological features, the histopathological features comprising features selected from the group consisting of fibrosis, inflammation, ballooning and steatosis;

applying a trained model for assessing a selected histopathological feature to the extracted image data to determine an index associated with said histopathological feature; and

determining a degree of NASH based on the determined index,

wherein training the model for assessing the selected histopathological feature comprises:

providing a plurality of training samples and a plurality of validation samples, each sample comprising a graded liver biopsy sample;

quantifying parameters of the histopathological features from image data of each of the training samples;

selecting a subset of quantified parameters, the subset including one or more parameters of the selected histopathological feature;

constructing a model for assessing the selected histopathological feature from the subset of quantified parameters such that each training sample has a corresponding value associated with the selected histopathological feature, wherein a set of continuous values is generated by the model based on the plurality of training samples; and

validating the constructed model using the validation samples.

2. The method as claimed in claim 1, wherein the subset of quantified parameters further includes one or more parameters of a histopathological feature other than the selected histopathological feature.

3. The method as claimed in claim 1 or 2, wherein the image data of each of the training samples is obtained by second harmonic generation (SHG) microscopy and/or two photon excitation fluorescence (TPEF) microscopy.

4. The method as claimed in any one of the preceding claims, wherein selecting the subset of quantified parameters comprises a sequential feature selection.

5. The method as claimed in claim 4, wherein the sequential feature selection uses a linear regression model, wherein a criterion of the linear regression model comprises a residual sum of squares and a search algorithm of the linear regression model comprises a sequential forward selection.

6. The method as claimed in any one of the preceding claims, wherein constructing the model for assessing the selected histopathological feature from the subset of quantified parameters comprises a linear regression procedure.

7. The method as claimed in claim 6, wherein the method further comprises determining cut-off values of each NASH grade by Youden's index.

8. The method as claimed in claim 7, wherein validating the model using the validation samples comprises:

for each validation sample, determining a quantitative value using the constructed model for assessing the selected histopathological feature, thereby determining the corresponding NASH grade; and

correlating the determined NASH grade with a grade provided by a pathologist.

9. A method for evaluating efficacy of a therapeutic intervention, the method comprising:

determining, from a first liver biopsy sample of a subject before the therapeutic intervention, a first degree of NASH using the method as claimed in any one of the preceding claims;

determining, from a second liver biopsy sample of the subject after the therapeutic intervention, a second degree of NASH using the method as claimed in any one of the preceding claims; and

comparing the first degree and second degree to determine efficacy of the therapeutic intervention.

10. A system for assessing nonalcoholic steatohepatitis (NASH) in a liver biopsy sample, the system comprising:

a processor; and

a computer-readable memory coupled to the processor and having instructions stored thereon that are executable by the processor to:

receive image data of the liver biopsy sample indicative of histopathological features, the histopathological features comprising features selected from the group consisting of fibrosis, inflammation, ballooning and steatosis;

apply a trained model for assessing a selected histopathological feature to the extracted image data to determine an index associated with said histopathological feature; and

determine a degree of NASH based on the determined index,

wherein the trained model for assessing the selected histopathological feature comprises:

a quantification module for quantifying parameters of the histopathological features from image data of each of a plurality of training samples, each training sample comprising a graded liver biopsy sample;

a selection module for selecting a subset of quantified parameters, the subset including one or more parameters of the selected histopathological feature;

a construction module for constructing a model for assessing the selected histopathological feature from the subset of quantified parameters such that each training sample has a corresponding value associated with the selected histopathological feature, wherein a set of continuous values is generated by the model based on the plurality of training samples; and

a validation module for validating the constructed model using a plurality of validation samples, each validation sample comprising a graded liver biopsy sample.

11. The system as claimed in claim 10, wherein the subset of quantified parameters further includes one or more parameters of a histopathological feature other than the selected histopathological feature.

12. The system as claimed in claim 10 or 11, wherein the image data of each of the training samples comprises data from a second harmonic generation (SHG) microscope and/or a two-photon excitation fluorescence (TPEF) microscope.

13. The system as claimed in any one of claim 10 to 12, wherein the selection module is configured to select the subset of quantified parameters by a sequential feature selection.

14. The system as claimed in claim 13, wherein the sequential feature selection uses a linear regression model, wherein a criterion of the linear regression model comprises a residual sum of squares and a search algorithm of the linear regression model comprises a sequential forward selection.

15. The system as claimed in any one of claims 10 to 14, wherein the construction module is configured to construct the model for assessing the selected histopathological feature from the subset of quantified parameters by a linear regression procedure.

16. The system as claimed in claim 15, wherein cut-off values of each NASH grade are determined by Youden’s index.

17. The system as claimed in claim 16, wherein the validation module is configured to:

for each validation sample, determine a quantitative value using the constructed model for assessing the selected histopathological feature, thereby determining the corresponding NASH grade; and

correlate the determined NASH grade with a grade provided by a pathologist.