

Package ‘curatedBladderData’

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Type Package

Title Bladder Cancer Gene Expression Analysis

Version 1.1.1

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Author Markus Riester

Maintainer Markus Riester <markus@jimmy.harvard.edu>

Description The curatedBladderData package provides relevant functions and data for gene expression analysis in patients with bladder cancer.

Depends R (>= 2.10.0), affy

Suggests BiocStyle, survival, xtable, sva, genefilter, logging

License Artistic-2.0

biocViews ExperimentData, Cancer, Bladder, RNAExpressionData

R topics documented:

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curatedBladderData-package

Clinically Annotated Data for the Bladder Cancer Transcriptome

Description

The curatedBladderData package provides manually curated clinical data, uniformly processed expression data, and convenience functions for gene expression analysis in patients with ovarian cancer.

Details

Package: curatedBladderData
Type: Package
Version: 1.1.1
Date: 2013-09-02
License: Artistic-2.0
Depends: R (>= 2.10.0), affy

Author(s)

Benjamin F. Ganzfried, Steve Skates, Markus Riester, Victoria Wang, Thomas Risch, Benjamin Haibe-Kains, Curtis Huttenhower, Svitlana Tyekucheva, Jie Ding, Ina Jazic, Michael Birrer, Giovanni Parmigiani, Levi Waldron

Department of Biostatistics and Computational Biology, Dana-Farber Cancer Institute, Harvard School of Public Health

Maintainer: Levi Waldron <levi@jimmy.harvard.edu>

Examples

```
##List all datasets:  
data(package="curatedBladderData")  
##
```

GSE13507_eset

Predictive value of progression-related gene classifier in primary non-muscle invasive bladder cancer.

Description

While several molecular markers of bladder cancer prognosis have been identified, the limited value of current prognostic markers has created the need for new molecular indicators of bladder cancer outcomes. The aim of this study was to identify genetic signatures associated with disease prognosis in bladder cancer. We used 272 primary bladder cancer specimens for microarray analysis and real-time reverse transcriptase polymerase chain reaction (RT-PCR) analysis. Microarray gene expression analysis of randomly selected 165 primary bladder cancer specimens as an original cohort was carried out. Risk scores were applied to stratify prognosis-related gene classifiers. Prognosis-related gene classifiers were individually analyzed with tumor invasiveness (non-muscle invasive bladder cancer [NMIBC] and muscle invasive bladder cancer [MIBC]) and prognosis. We validated selected gene classifiers using RT-PCR in the original (165) and independent (107) cohorts. Ninety-seven genes related to disease progression among NMIBC patients were identified by microarray data analysis. Eight genes, a progression-related gene classifier in NMIBC, were selected for RT-PCR. The progression-related gene classifier in patients with NMIBC was closely correlated with progression in both original and independent cohorts. Furthermore, no patient with NMIBC in the good-prognosis signature group experienced cancer progression. We identified progression-related gene classifier that has strong predictive value for determining disease outcome in NMIBC. This gene classifier could assist in selecting NMIBC patients who might benefit from more aggressive therapeutic intervention or surveillance.

Usage

```
data( GSE13507_eset )
```

Format

```
experimentData(eset):
```

```
Experiment data
```

```
  Experimenter name: Kim WJ, Kim EJ, Kim SK, Kim YJ et al. Predictive value of progression-related gene classifier in primary non-muscle invasive bladder cancer
```

```
  Laboratory: Kim, Bae 2010
```

```
  Contact information:
```

```
  Title: Predictive value of progression-related gene classifier in primary non-muscle invasive bladder cancer
```

```
  URL:
```

```
  PMIDs: 20059769
```

```
  Abstract: A 223 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
    platform_title:
```

```
      Illumina human-6 v2.0 expression beadchip
```

```
    platform_shorttitle:
```

```
      Illumina human-6 v2.0
```

```
    platform_summary:
```

```
      illuminaHumanv2
```

```
    platform_manufacturer:
```

```
      Illumina
```

```
    platform_distribution:
```

```
      commercial
```

```
platform_accession:
  GPL6102
platform_technology:
  oligonucleotide beads
```

```
Preprocessing: default
featureData(eset):
An object of class AnnotatedDataFrame
  featureNames: A1BG A1CF ... ZZZ3 (19329 total)
  varLabels: probeset gene
  varMetadata: labelDescription
```

Details

```
assayData: 19329 features, 255 samples
Platform type: illuminaHumanv2
Overall survival time-to-event summary (in years):
Call: survfit(formula = Surv(time, cens) ~ -1)
```

```
90 observations deleted due to missingness
records  n.max n.start  events  median 0.95LCL 0.95UCL
165.00 165.00 165.00  69.00   7.26   5.53   NA
```

```
-----
Available sample meta-data:
-----
```

```
alt_sample_name:
  Length      Class      Mode
    255 character character
```

```
sample_type:
adjacentnormal      healthy      metastatic      tumor
           58           10           22           165
```

```
summarystage:
  invasive superficial      NAs
           62           103           90
```

```
T:
  Min. 1st Qu.  Median    Mean 3rd Qu.  Max.  NAs
0.000  1.000   1.000  1.473  2.000  4.000  90
```

```
N:
  0  1  2  3 NAs
133 8  4  1 109
```

```
M:
```

```

0      1 NAs
157    8  90

age:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NAs
 24.00  59.00   66.00   65.18  73.00   88.00    90

gender:
  f      m NAs
 30    135  90

adjuvant_chemo:
  n      y NAs
 138    27  90

days_to_death:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NAs
   31    521   1113   1473   2258   4169    90

vital_status:
deceased  living    NAs
   69      96     90

dfs_event:
 doc  dod  ned NAs
 37   32   96  90

uncurated_author_metadata:
  Length    Class      Mode
   255 character character

```

GSE1827_eset

Bladder cancer outcome and subtype classification by gene expression.

Description

Models of bladder tumor progression have suggested that genetic alterations may determine both phenotype and clinical course. We have applied expression microarray analysis to a divergent set of bladder tumors to further elucidate the course of disease progression and to classify tumors into more homogeneous and clinically relevant subgroups. cDNA microarrays containing 10,368 human gene elements were used to characterize the global gene expression patterns in 80 bladder tumors, 9 bladder cancer cell lines, and 3 normal bladder samples. Robust statistical approaches accounting for the multiple testing problem were used to identify differentially expressed genes. Unsupervised hierarchical clustering successfully separated the samples into two subgroups containing superficial (pT(a) and pT(1)) versus muscle-invasive (pT(2)-pT(4)) tumors. Supervised classification had a

90.5% success rate separating superficial from muscle-invasive tumors based on a limited subset of genes. Tumors could also be classified into transitional versus squamous subtypes (89% success rate) and good versus bad prognosis (78% success rate). The performance of our stage classifiers was confirmed in silico using data from an independent tumor set. Validation of differential expression was done using immunohistochemistry on tissue microarrays for cathepsin E, cyclin A2, and parathyroid hormone-related protein. Genes driving the separation between tumor subsets may prove to be important biomarkers for bladder cancer development and progression and eventually candidates for therapeutic targeting.

Usage

```
data( GSE1827_eset )
```

Format

```
experimentData(eset):
```

```
Experiment data
```

```
  Experimenter name: Blaveri E, Simko JP, Korkola JE, Brewer JL, Baehner F, Mehta K, Devries S, Koppie T,
```

```
  Laboratory: Blaveri, Waldman 2005
```

```
  Contact information:
```

```
  Title: Bladder cancer outcome and subtype classification by gene expression.
```

```
  URL:
```

```
  PMIDs: 15930339
```

```
  Abstract: A 216 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
    platform_title:
```

```
      JAKE
```

```
    platform_shorttitle:
```

```
      JAKE
```

```
    platform_summary:
```

```
      JAKE
```

```
    platform_manufacturer:
```

```
      other
```

```
    platform_distribution:
```

```
      non-commercial
```

```
    platform_accession:
```

```
      GPL1479
```

```
    platform_technology:
```

```
      spotted DNA/cDNA
```

```
Preprocessing: default
```

```
featureData(eset):
```

```
An object of class AnnotatedDataFrame
```

```
  featureNames: A2M AADAC ... ZZEF1 (6225 total)
```

```
  varLabels: probeset gene
```

```
  varMetadata: labelDescription
```

Details

assayData: 6225 features, 80 samples

Platform type: JAKE

Overall survival time-to-event summary (in years):

Call: survfit(formula = Surv(time, cens) ~ -1)

records	n.max	n.start	events	median	0.95LCL	0.95UCL
80.000	80.000	80.000	44.000	2.301	0.978	NA

 Available sample meta-data:

alt_sample_name:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
44.0	360.0	452.5	425.1	513.2	591.0

sample_type:

tumor
80

surgery_type:

rc	turbt
50	30

histological_type:

squamous	tcc
6	74

summarygrade:

high	low
67	13

summarystage:

invasive	superficial
53	27

T:

0	1	2	3	4
17	10	14	26	13

N:

0	1	2	NAs
29	6	11	34

M:

0	1	NAs
3	2	75

```

age:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NAs
  28.00  57.25   66.00   65.56  73.00  113.00    2

gender:
  f  m
  24 56

recurrence_status:
  norecurrence  recurrence    NAs
                49          24    7

days_to_death:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  4.0   217.5   386.0   842.2 1280.0  4348.0

vital_status:
  deceased  living
    44      36

uncurated_author_metadata:
  Length    Class    Mode
    80 character character

```

GSE19915.GPL3883_eset *Combined gene expression and genomic profiling define two intrinsic molecular subtypes of urothelial carcinoma and gene signatures for molecular grading and outcome.*

Description

In the present investigation, we sought to refine the classification of urothelial carcinoma by combining information on gene expression, genomic, and gene mutation levels. For these purposes, we performed gene expression analysis of 144 carcinomas, and whole genome array-CGH analysis and mutation analyses of FGFR3, PIK3CA, KRAS, HRAS, NRAS, TP53, CDKN2A, and TSC1 in 103 of these cases. Hierarchical cluster analysis identified two intrinsic molecular subtypes, MS1 and MS2, which were validated and defined by the same set of genes in three independent bladder cancer data sets. The two subtypes differed with respect to gene expression and mutation profiles, as well as with the level of genomic instability. The data show that genomic instability was the most distinguishing genomic feature of MS2 tumors, and that this trait was not dependent on TP53/MDM2 alterations. By combining molecular and pathologic data, it was possible to distinguish two molecular subtypes of T(a) and T(1) tumors, respectively. In addition, we define gene signatures validated in two independent data sets that classify urothelial carcinoma into low-grade (G(1)/G(2)) and high-grade (G(3)) tumors as well as non-muscle and muscle-invasive tumors with

high precisions and sensitivities, suggesting molecular grading as a relevant complement to standard pathologic grading. We also present a gene expression signature with independent prognostic effect on metastasis and disease-specific survival. We conclude that the combination of molecular and histopathologic classification systems might provide a strong improvement for bladder cancer classification and produce new insights into the development of this tumor type.(c)2010 AACR.

Usage

```
data( GSE19915.GPL3883_eset )
```

Format

```
experimentData(eset):
```

```
Experiment data
```

```
  Experimenter name: Lindgren D, Frigyesi A, Gudjonsson S, Sj?dahl G et al. Combined gene expression and
```

```
  Laboratory: Lindgren, H?glund 2010
```

```
  Contact information:
```

```
  Title: Combined gene expression and genomic profiling define two intrinsic molecular subtypes of uroth
```

```
  URL:
```

```
  PMIDs: 20406976
```

```
  Abstract: A 247 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
    platform_title:
```

```
      Swegene Human 27K RAP UniGene188 array
```

```
    platform_shorttitle:
```

```
      Swegene Human 27K
```

```
    platform_summary:
```

```
    platform_manufacturer:
```

```
      other
```

```
    platform_distribution:
```

```
      non-commercial
```

```
    platform_accession:
```

```
      GPL3883
```

```
    platform_technology:
```

```
      spotted DNA/cDNA
```

```
Preprocessing: default
```

```
featureData(eset):
```

```
An object of class AnnotatedDataFrame
```

```
  featureNames: 13CDNA73 15E1.2 ... raptor|MGC14560 (10585 total)
```

```
  varLabels: probeset gene
```

```
  varMetadata: labelDescription
```

Details

assayData: 10585 features, 84 samples
 Platform type:
 Overall survival time-to-event summary (in years):
 Call: survfit(formula = Surv(time, cens) ~ -1)

10 observations deleted due to missingness
 records n.max n.start events median 0.95LCL 0.95UCL
 74 74 74 4 NA NA NA

 Available sample meta-data:

alt_sample_name:
 Length Class Mode
 84 character character

sample_type:
 healthy tumor
 8 76

summarystage:
 invasive superficial NAs
 2 73 9

T:
 0 1 3 NAs
 56 17 2 9

G:
 1 2 3 NAs
 24 38 13 9

days_to_death:
 Min. 1st Qu. Median Mean 3rd Qu. Max. NAs
 0 1231 1720 1552 1937 2429 10

vital_status:
 deceased living NAs
 4 70 10

uncurated_author_metadata:
 Length Class Mode
 84 character character

GSE19915.GPL5186_eset *Combined gene expression and genomic profiling define two intrinsic molecular subtypes of urothelial carcinoma and gene signatures for molecular grading and outcome.*

Description

In the present investigation, we sought to refine the classification of urothelial carcinoma by combining information on gene expression, genomic, and gene mutation levels. For these purposes, we performed gene expression analysis of 144 carcinomas, and whole genome array-CGH analysis and mutation analyses of FGFR3, PIK3CA, KRAS, HRAS, NRAS, TP53, CDKN2A, and TSC1 in 103 of these cases. Hierarchical cluster analysis identified two intrinsic molecular subtypes, MS1 and MS2, which were validated and defined by the same set of genes in three independent bladder cancer data sets. The two subtypes differed with respect to gene expression and mutation profiles, as well as with the level of genomic instability. The data show that genomic instability was the most distinguishing genomic feature of MS2 tumors, and that this trait was not dependent on TP53/MDM2 alterations. By combining molecular and pathologic data, it was possible to distinguish two molecular subtypes of T(a) and T(1) tumors, respectively. In addition, we define gene signatures validated in two independent data sets that classify urothelial carcinoma into low-grade (G(1)/G(2)) and high-grade (G(3)) tumors as well as non-muscle and muscle-invasive tumors with high precisions and sensitivities, suggesting molecular grading as a relevant complement to standard pathologic grading. We also present a gene expression signature with independent prognostic effect on metastasis and disease-specific survival. We conclude that the combination of molecular and histopathologic classification systems might provide a strong improvement for bladder cancer classification and produce new insights into the development of this tumor type.(c)2010 AACR.

Usage

```
data( GSE19915.GPL5186_eset )
```

Format

```
experimentData(eset):
```

```
Experiment data
```

```
  Experimenter name: Lindgren D, Frigyesi A, Gudjonsson S, Sj?dahl G et al. Combined gene expression and
```

```
  Laboratory: Lindgren, H?glund 2010
```

```
  Contact information:
```

```
  Title: Combined gene expression and genomic profiling define two intrinsic molecular subtypes of uroth
```

```
  URL:
```

```
  PMIDs: 20406976
```

```
  Abstract: A 247 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
  platform_title:
```

```
    SWEGENE H_v3.0.1 35K
```

```
  platform_shorttitle:
```

```

      SWEGENE H_v3.0.1 35K
platform_summary:

platform_manufacturer:
  other
platform_distribution:
  non-commercial
platform_accession:
  GPL5186
platform_technology:
  spotted oligonucleotide

```

```

Preprocessing: default
featureData(eset):
An object of class AnnotatedDataFrame
  featureNames: 15E1_HUMAN 38596 ... ZZZ3 (12391 total)
  varLabels: probeset gene
  varMetadata: labelDescription

```

Details

```

assayData: 12391 features, 98 samples
Platform type:
Overall survival time-to-event summary (in years):
Call: survfit(formula = Surv(time, cens) ~ -1)

      11 observations deleted due to missingness
records  n.max n.start  events  median 0.95LCL 0.95UCL
      87    87    87    26     NA     NA     NA

```

```

-----
Available sample meta-data:
-----

```

```

alt_sample_name:
  Length    Class      Mode
      98 character character

```

```

sample_type:
healthy  tumor
      7    91

```

```

summarystage:
  invasive superficial  NAs
      45          43    10

```

```

T:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NAs

```

```

0.000  1.000  2.000  1.693  3.000  4.000  10

G:
  2    3 NAs
19  71   8

days_to_death:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NAs
  3.0   692.5 1117.0 1067.0 1512.0 2335.0   11

vital_status:
deceased  living    NAs
   26      61     11

uncurated_author_metadata:
  Length    Class      Mode
   98 character character

```

GSE31189_eset

A candidate molecular biomarker panel for the detection of bladder cancer.

Description

Bladder cancer is among the five most common malignancies worldwide, and due to high rates of recurrence, one of the most prevalent. Improvements in noninvasive urine-based assays to detect bladder cancer would benefit both patients and health care systems. In this study, the goal was to identify urothelial cell transcriptomic signatures associated with bladder cancer. Gene expression profiling (Affymetrix U133 Plus 2.0 arrays) was applied to exfoliated urothelia obtained from a cohort of 92 subjects with known bladder disease status. Computational analyses identified candidate biomarkers of bladder cancer and an optimal predictive model was derived. Selected targets from the profiling analyses were monitored in an independent cohort of 81 subjects using quantitative real-time PCR (RT-PCR). Transcriptome profiling data analysis identified 52 genes associated with bladder cancer ($P < 0.001$) and gene models that optimally predicted class label were derived. RT-PCR analysis of 48 selected targets in an independent cohort identified a 14-gene diagnostic signature that predicted the presence of bladder cancer with high accuracy. Exfoliated urothelia sampling provides a robust analyte for the evaluation of patients with suspected bladder cancer. The refinement and validation of the multigene urothelial cell signatures identified in this preliminary study may lead to accurate, noninvasive assays for the detection of bladder cancer. The development of an accurate, noninvasive bladder cancer detection assay would benefit both the patient and health care systems through better detection, monitoring, and control of disease.

Usage

```
data( GSE31189_eset )
```

Format

```

experimentData(eset):
Experiment data
  Experimenter name: Urquidi V, Goodison S, Cai Y, Sun Y et al. A candidate molecular biomarker panel for
  Laboratory: Urquidi, Rosser 2012
  Contact information:
  Title: A candidate molecular biomarker panel for the detection of bladder cancer.
  URL:
  PMIDs: 23097579

  Abstract: A 230 word abstract is available. Use abstract method.
  Information is available on: preprocessing
  notes:
  platform_title:
    [HG-U133_Plus_2] Affymetrix Human Genome U133 Plus 2.0 Array
  platform_shorttitle:
    Affymetrix HG-U133Plus2
  platform_summary:
    hgu133plus2
  platform_manufacturer:
    Affymetrix
  platform_distribution:
    commercial
  platform_accession:
    GPL570
  platform_technology:
    in situ oligonucleotide

Preprocessing: frma
featureData(eset):
An object of class AnnotatedDataFrame
  featureNames: A1BG A1BG-AS1 ... ZZZ3 (19381 total)
  varLabels: probeset gene
  varMetadata: labelDescription

```

Details

```

assayData: 19381 features, 92 samples
Platform type: hgu133plus2
-----
Available sample meta-data:
-----

alt_sample_name:
  Length      Class      Mode
    92 character character

```

```

sample_type:
healthy  tumor
   40    52

batch:
  Length  Class  Mode
    92 character character

uncurated_author_metadata:
  Length  Class  Mode
    92 character character

```

GSE31684_eset	<i>Combination of a novel gene expression signature with a clinical nomogram improves the prediction of survival in high-risk bladder cancer.</i>
---------------	---

Description

We aimed to validate and improve prognostic signatures for high-risk urothelial carcinoma of the bladder. We evaluated microarray data from 93 patients with bladder cancer managed by radical cystectomy to determine gene expression patterns associated with clinical and prognostic variables. We compared our results with published bladder cancer microarray data sets comprising 578 additional patients and with 49 published gene signatures from multiple cancer types. Hierarchical clustering was utilized to identify subtypes associated with differences in survival. We then investigated whether the addition of survival-associated gene expression information to a validated postcystectomy nomogram utilizing clinical and pathologic variables improves prediction of recurrence. Multiple markers for muscle invasive disease with highly significant expression differences in multiple data sets were identified, such as fibronectin 1 (FN1), NNMT, POSTN, and SMAD6. We identified signatures associated with pathologic stage and the likelihood of developing metastasis and death from bladder cancer, as well as with two distinct clustering subtypes of bladder cancer. Our novel signature correlated with overall survival in multiple independent data sets, significantly improving the prediction concordance of standard staging in all data sets [mean Δ C-statistic: 0.14; 95% confidence interval (CI), 0.01-0.27; $P < 0.001$]. Tested in our patient cohort, it significantly enhanced the performance of a postoperative survival nomogram (Δ C-statistic: 0.08, 95% CI, -0.04-0.20; $P < 0.005$). Prognostic information obtained from gene expression data can aid in post-treatment prediction of bladder cancer recurrence. Our findings require further validation in external cohorts and prospectively in a clinical trial setting.

Usage

```
data( GSE31684_eset )
```

Format

```

experimentData(eset):
Experiment data
  Experimenter name: Riester M, Taylor JM, Feifer A, Koppie T et al. Combination of a novel gene expression
  Laboratory: Riester, Michor 2012
  Contact information:
  Title: Combination of a novel gene expression signature with a clinical nomogram improves the prediction
  URL:
  PMIDs: 22228636

```

```

Abstract: A 243 word abstract is available. Use abstract method.
Information is available on: preprocessing

```

```

notes:

```

```

platform_title:
  [HG-U133_Plus_2] Affymetrix Human Genome U133 Plus 2.0 Array
platform_shorttitle:
  Affymetrix HG-U133Plus2
platform_summary:
  hgu133plus2
platform_manufacturer:
  Affymetrix
platform_distribution:
  commercial
platform_accession:
  GPL570
platform_technology:
  in situ oligonucleotide

```

```

Preprocessing: frma

```

```

featureData(eset):

```

```

An object of class AnnotatedDataFrame
  featureNames: A1BG A1BG-AS1 ... ZZZ3 (19381 total)
  varLabels: probeset gene
  varMetadata: labelDescription

```

Details

```

assayData: 19381 features, 93 samples
Platform type: hgu133plus2
Overall survival time-to-event summary (in years):
Call: survfit(formula = Surv(time, cens) ~ -1)

```

records	n.max	n.start	events	median	0.95LCL	0.95UCL
93.00	93.00	93.00	65.00	2.74	1.37	7.52

```

-----
Available sample meta-data:

```



```

-----
alt_sample_name:
  Length   Class   Mode
    93 character character

sample_type:
tumor
  93

surgery_type:
rc
  93

histological_type:
  cis squamous   tcc
    2      5      86

summarygrade:
high low
  87   6

summarystage:
  invasive superficial
    78      15

T:
  0 1 2 3 4
  5 10 17 42 19

N:
  0 1 NAs
  49 28 16

M:
  0 1
  57 36

age:
  Min. 1st Qu.  Median    Mean 3rd Qu.  Max.
  42.00  62.00   69.00   69.11  75.00   91.00

gender:
  f m
  25 68

neoadjuvant_chemo:
  n y

```

90 3

adjuvant_chemo:

n y

58 35

days_to_tumor_recurrence:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
12	170	495	1307	2574	5342

recurrence_status:

norecurrence recurrence

54 39

days_to_death:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
12	299	953	1445	2616	5342

vital_status:

deceased living

65 28

dfs_event:

doc dod ned

27 38 28

smoking_status:

current former never

19 56 18

smoking_package_years:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NAs
5.00	22.50	40.00	44.13	60.00	120.00	22

nomogram_score:

Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
1.00	21.11	46.60	44.99	67.29	92.15

batch:

Length Class Mode

93 character character

uncurated_author_metadata:

Length Class Mode

93 character character

GSE32894_eset

*A molecular taxonomy for urothelial carcinoma.***Description**

Even though urothelial cancer is the fourth most common tumor type among males, progress in treatment has been scarce. A problem in day-to-day clinical practice is that precise assessment of individual tumors is still fairly uncertain; consequently efforts have been undertaken to complement tumor evaluation with molecular biomarkers. An extension of this approach would be to base tumor classification primarily on molecular features. Here, we present a molecular taxonomy for urothelial carcinoma based on integrated genomics. We use gene expression profiles from 308 tumor cases to define five major urothelial carcinoma subtypes: urobasal A, genomically unstable, urobasal B, squamous cell carcinoma like, and an infiltrated class of tumors. Tumor subtypes were validated in three independent publically available data sets. The expression of 11 key genes was validated at the protein level by immunohistochemistry. The subtypes show distinct clinical outcomes and differ with respect to expression of cell-cycle genes, receptor tyrosine kinases particularly FGFR3, ERBB2, and EGFR, cytokeratins, and cell adhesion genes, as well as with respect to FGFR3, PIK3CA, and TP53 mutation frequency. The molecular subtypes cut across pathologic classification, and class-defining gene signatures show coordinated expression irrespective of pathologic stage and grade, suggesting the molecular phenotypes as intrinsic properties of the tumors. Available data indicate that susceptibility to specific drugs is more likely to be associated with the molecular stratification than with pathologic classification. We anticipate that the molecular taxonomy will be useful in future clinical investigations. 2012 AACR.

Usage

```
data( GSE32894_eset )
```

Format

```
experimentData(eset):
Experiment data
  Experimenter name: Sj?dahl G, Lauss M, L?vgren K, Chebil G et al. A molecular taxonomy for urothelial ca
  Laboratory: Sj?dahl, H?glund 2012
  Contact information:
  Title: A molecular taxonomy for urothelial carcinoma.
  URL:
  PMIDs: 22553347

Abstract: A 236 word abstract is available. Use abstract method.
Information is available on: preprocessing
notes:
  platform_title:
    Illumina HumanHT-12 V3.0 expression beadchip
  platform_shorttitle:
    Illumina HumanHT-12 V3.0
  platform_summary:
```

```

illuminaHumanv3
platform_manufacturer:
  Illumina
platform_distribution:
  commercial
platform_accession:
  GPL6947
platform_technology:
  oligonucleotide beads

```

```

Preprocessing: default
featureData(eset):
An object of class AnnotatedDataFrame
  featureNames: A1CF A2M ... ZZZ3 (15638 total)
  varLabels: probeset gene
  varMetadata: labelDescription

```

Details

```

assayData: 15638 features, 308 samples
Platform type: illuminaHumanv3
Overall survival time-to-event summary (in years):
Call: survfit(formula = Surv(time, cens) ~ -1)

```

```

      84 observations deleted due to missingness
records  n.max n.start  events  median 0.95LCL 0.95UCL
      224   224   224    25      NA      NA      NA

```

```

-----
Available sample meta-data:
-----

```

```

alt_sample_name:
  Length      Class      Mode
      308 character character

```

```

sample_type:
tumor
      308

```

```

summarystage:
  invasive superficial      NAs
      93      213      2

```

```

T:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NAs
0.0000 0.0000  1.0000  0.9542 2.0000  4.0000    2

```

```

G:
  1   2   3   4 NAs
48 103 154  1   2

N:
  0   1   2   3 NAs
48  4  10  1 245

age:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 20.00  62.75   71.00   70.61  79.00   96.00

gender:
  f   m
80 228

days_to_death:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NAs
  6.0  552.5 1068.0 1214.0 1766.0 3357.0   84

vital_status:
deceased  living   NAs
      25      199      84

dfs_event:
dod NAs
 25 283

uncurated_author_metadata:
  Length    Class      Mode
    308 character character

```

GSE37317_eset

Transcriptional signatures of Ral GTPase are associated with aggressive clinicopathologic characteristics in human cancer.

Description

RalA and RalB are small GTPases that support malignant development and progression in experimental models of bladder, prostate, and squamous cancer. However, demonstration of their clinical relevance in human tumors remains lacking. Here, we developed tools to evaluate Ral protein expression, activation, and transcriptional output and evaluated their association with clinicopathologic parameters in common human tumor types. To evaluate the relevance of Ral activation and transcriptional output, we correlated RalA and RalB activation with the mutational status of key human bladder cancer genes. We also identified and evaluated a transcriptional signature of genes that correlates with depletion of RalA and RalB in vivo. The Ral transcriptional signature score, but

not protein expression as evaluated by immunohistochemistry, predicted disease stage, progression to muscle invasion, and survival in human bladder cancers and metastatic and stem cell phenotypes in bladder cancer models. In prostate cancer, the Ral transcriptional signature score was associated with seminal vesicle invasion, androgen-independent progression, and reduced survival. In squamous cell carcinoma, this score was decreased in cancer tissues compared with normal mucosa, validating the experimental findings that Ral acts as a tumor suppressor in this tumor type. Together, our findings show the clinical relevance of Ral in human cancer and provide a rationale for the development of Ral-directed therapies.

Usage

```
data( GSE37317_eset )
```

Format

```
experimentData(eset):
```

```
Experiment data
```

```
  Experimenter name: Smith SC, Baras AS, Owens CR, Dancik G et al. Transcriptional signatures of Ral GTPase
```

```
  Laboratory: Smith, Theodorescu 2012
```

```
  Contact information:
```

```
  Title: Transcriptional signatures of Ral GTPase are associated with aggressive clinicopathologic characteristics
```

```
  URL:
```

```
  PMIDs: 22586063
```

```
  Abstract: A 210 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
    platform_title:
```

```
      [HG-U133A] Affymetrix Human Genome U133A Array
```

```
    platform_shorttitle:
```

```
      Affymetrix HG-U133A
```

```
    platform_summary:
```

```
      hgu133a
```

```
    platform_manufacturer:
```

```
      Affymetrix
```

```
    platform_distribution:
```

```
      commercial
```

```
    platform_accession:
```

```
      GPL96
```

```
    platform_technology:
```

```
      in situ oligonucleotide
```

```
Preprocessing: frma
```

```
featureData(eset):
```

```
An object of class AnnotatedDataFrame
```

```
  featureNames: A1CF A2M ... ZZZ3 (13013 total)
```

```
  varLabels: probeset gene
```

```
  varMetadata: labelDescription
```

Details

assayData: 13013 features, 19 samples

Platform type: hgu133a

 Available sample meta-data:

alt_sample_name:

Length	Class	Mode
19	character	character

sample_type:

tumor
19

histological_type:

squamous	tcc
1	18

summarystage:

invasive	superficial
11	8

T:

0	1	2	3	4
4	4	4	3	4

batch:

Length	Class	Mode
19	character	character

uncurated_author_metadata:

Length	Class	Mode
19	character	character

GSE5287_eset

Emmprin and survivin predict response and survival following cisplatin-containing chemotherapy in patients with advanced bladder cancer.

Description

Cisplatin-containing chemotherapy is the standard of care for patients with locally advanced and metastatic transitional cell carcinoma of the urothelium. The response rate is approximately 50% and tumor-derived molecular prognostic markers are desirable for improved estimation of response

and survival. Affymetrix GeneChip expression profiling was carried out using tumor material from 30 patients. A set of genes with an expression highly correlated to survival time after chemotherapy was identified. Two genes were selected for validation by immunohistochemistry in an independent material of 124 patients receiving cisplatin-containing therapy. Fifty-five differentially expressed genes correlated significantly to survival time. Two of the protein products (emmprin and survivin) were validated using immunohistochemistry. Multivariate analysis identified emmprin expression (hazard ratio, 2.23; $P < 0.0001$) and survivin expression (hazard ratio, 2.46; $P < 0.0001$) as independent prognostic markers for poor outcome, together with the presence of visceral metastases (hazard ratio, 2.62; $P < 0.0001$). In the clinical good prognostic group of patients without visceral metastases, both markers showed significant discriminating power as supplemental risk factors ($P < 0.0001$). Within this group of patients, the subgroups of patients with no positive, one positive, or two positive immunohistochemistry scores (emmprin and survivin) had estimated 5-year survival rates of 44.0%, 21.1%, and 0%, respectively. Response to chemotherapy could also be predicted with an odds ratio of 4.41 (95% confidence interval, 1.91-10.1) and 2.48 (95% confidence interval, 1.1-5.5) for emmprin and survivin, respectively. Emmprin and survivin proteins were identified as strong independent prognostic factors for response and survival after cisplatin-containing chemotherapy in patients with advanced bladder cancer.

Usage

```
data( GSE5287_eset )
```

Format

```
experimentData(eset):
Experiment data
```

```
  Experimenter name: Als AB, Dyrskj?t L, von der Maase H, Koed K et al. Emmprin and survivin predict respo
```

```
  Laboratory: Als, Orntoft 2007
```

```
  Contact information:
```

```
  Title: Emmprin and survivin predict response and survival following cisplatin-containing chemotherapy
```

```
  URL:
```

```
  PMIDs: 17671123
```

```
  Abstract: A 254 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
  platform_title:
```

```
    [HG-U133A] Affymetrix Human Genome U133A Array
```

```
  platform_shorttitle:
```

```
    Affymetrix HG-U133A
```

```
  platform_summary:
```

```
    hgu133a
```

```
  platform_manufacturer:
```

```
    Affymetrix
```

```
  platform_distribution:
```

```
    commercial
```

```
  platform_accession:
```

```
    GPL96
```

```
  platform_technology:
```


in situ oligonucleotide

```
Preprocessing: frma
featureData(eset):
An object of class AnnotatedDataFrame
  featureNames: A1CF A2M ... ZZZ3 (13013 total)
  varLabels: probeset gene
  varMetadata: labelDescription
```

Details

```
assayData: 13013 features, 30 samples
Platform type: hgu133a
Overall survival time-to-event summary (in years):
Call: survfit(formula = Surv(time, cens) ~ -1)

records  n.max n.start  events  median 0.95LCL 0.95UCL
   30.00  30.00  30.00   25.00    4.36    3.12    7.81
```

Available sample meta-data:

```
alt_sample_name:
  Length      Class      Mode
     30 character character
```

```
sample_type:
tumor
   30
```

```
summarystage:
invasive
   30
```

```
T:
  4
 30
```

```
neoadjuvant_chemo:
  n
 30
```

```
adjuvant_chemo:
  y
 30
```

```
adjuvant_regimen:
```

```

cisplatin
  30

days_to_death:
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  420   1080   1590   3160   2962   12600

vital_status:
deceased  living
   25      5

batch:
  Length    Class      Mode
   30 character character

uncurated_author_metadata:
  Length    Class      Mode
   30 character character

```

GSE89_eset

Identifying distinct classes of bladder carcinoma using microarrays.

Description

Bladder cancer is a common malignant disease characterized by frequent recurrences. The stage of disease at diagnosis and the presence of surrounding carcinoma in situ are important in determining the disease course of an affected individual. Despite considerable effort, no accepted immunohistological or molecular markers have been identified to define clinically relevant subsets of bladder cancer. Here we report the identification of clinically relevant subclasses of bladder carcinoma using expression microarray analysis of 40 well characterized bladder tumors. Hierarchical cluster analysis identified three major stages, Ta, T1 and T2-4, with the Ta tumors further classified into subgroups. We built a 32-gene molecular classifier using a cross-validation approach that was able to classify benign and muscle-invasive tumors with close correlation to pathological staging in an independent test set of 68 tumors. The classifier provided new predictive information on disease progression in Ta tumors compared with conventional staging ($P < 0.005$). To delineate non-recurring Ta tumors from frequently recurring Ta tumors, we analyzed expression patterns in 31 tumors by applying a supervised learning classification methodology, which classified 75% of the samples correctly ($P < 0.006$). Furthermore, gene expression profiles characterizing each stage and subtype identified their biological properties, producing new potential targets for therapy.

Usage

```
data( GSE89_eset )
```

Format

```

experimentData(eset):
Experiment data
  Experimenter name: Dyrskj?t L, Thykjaer T, Kruh?ffer M, Jensen JL et al. Identifying distinct classes o
  Laboratory: Dyrskjot, Orntoft 2003
  Contact information:
  Title: Identifying distinct classes of bladder carcinoma using microarrays.
  URL:
  PMIDs: 12469123

  Abstract: A 202 word abstract is available. Use abstract method.
  Information is available on: preprocessing
  notes:
  platform_title:
    [Hu6800] Affymetrix Human Full Length HuGeneFL Array
  platform_shorttitle:
    Affymetrix HuGeneFL
  platform_summary:
    hu6800
  platform_manufacturer:
    Affymetrix
  platform_distribution:
    commercial
  platform_accession:
    GPL80
  platform_technology:
    in situ oligonucleotide

Preprocessing: rma
featureData(eset):
An object of class AnnotatedDataFrame
  featureNames: A2M AADAC ... ZYX (5466 total)
  varLabels: probeset gene
  varMetadata: labelDescription

```

Details

```

assayData: 5466 features, 40 samples
Platform type: hu6800
-----
Available sample meta-data:
-----

alt_sample_name:
  Length      Class      Mode
    40 character character

```

```

sample_type:
  tumor
    40

summarystage:
  invasive superficial
    9          31

T:
  0 1 2
20 11 9

G:
  2 3 4 NAs
  6 32 1 1

uncurated_author_metadata:
  Length      Class      Mode
    40 character character

```

```
PMID17099711.GPL8300_eset
```

Regional copy number-independent deregulation of transcription in cancer.

Description

Genetic and epigenetic alterations have been identified that lead to transcriptional deregulation in cancers. Genetic mechanisms may affect single genes or regions containing several neighboring genes, as has been shown for DNA copy number changes. It was recently reported that epigenetic suppression of gene expression can also extend to a whole region; this is known as long-range epigenetic silencing. Various techniques are available for identifying regional genetic alterations, but no large-scale analysis has yet been carried out to obtain an overview of regional epigenetic alterations. We carried out an exhaustive search for regions susceptible to such mechanisms using a combination of transcriptome correlation map analysis and array CGH data for a series of bladder carcinomas. We validated one candidate region experimentally, demonstrating histone methylation leading to the loss of expression of neighboring genes without DNA methylation.

Usage

```
data( PMID17099711.GPL8300_eset )
```

Format

```
experimentData(eset):
Experiment data
```

Experimenter name: Stransky N, Vallot C, Reyal F, Bernard-Pierrot I, de Medina SG, Segraves R, de Rycke
 Laboratory: Stransky, Radvany 2006
 Contact information:
 Title: Regional copy number-independent deregulation of transcription in cancer.
 URL:
 PMIDs: 17099711

Abstract: A 136 word abstract is available. Use abstract method.
 Information is available on: preprocessing
 notes:

platform_title:
 [HG_U95Av2] Affymetrix Human Genome U95 Version 2 Array
 platform_shorttitle:
 Affymetrix U95Av2
 platform_summary:
 hgu95av2
 platform_manufacturer:
 Affymetrix
 platform_distribution:
 commercial
 platform_accession:
 GPL8300
 platform_technology:
 NA

Preprocessing: rma
 featureData(eset):
 An object of class AnnotatedDataFrame
 featureNames: AADAC AAK1 ... ZZZ3 (8950 total)
 varLabels: probeset gene
 varMetadata: labelDescription

Details

assayData: 8950 features, 30 samples
 Platform type: hgu95av2

 Available sample meta-data:

unique_patient_ID:
 Length Class Mode
 30 character character

sample_type:
 tumor
 30

```

summarystage:
  invasive superficial
      14      16

T:
  0 1 2 3 4
10 6 1 5 8

substage:
  a  b NAs
 13  6  11

G:
  1 2 3
  8 5 17

N:
  0 1 2 NAs
18 3 5 4

M:
  0 NAs
 26 4

gender:
  f m
  5 25

batch:
2002-01-23 2002-01-24 2002-09-20 2003-03-06
           6           3           14           7

uncurated_author_metadata:
  Length      Class      Mode
    30 character character

```

PMID17099711.GPL91_eset

Regional copy number-independent deregulation of transcription in cancer.

Description

Genetic and epigenetic alterations have been identified that lead to transcriptional deregulation in cancers. Genetic mechanisms may affect single genes or regions containing several neighboring genes, as has been shown for DNA copy number changes. It was recently reported that epigenetic

suppression of gene expression can also extend to a whole region; this is known as long-range epigenetic silencing. Various techniques are available for identifying regional genetic alterations, but no large-scale analysis has yet been carried out to obtain an overview of regional epigenetic alterations. We carried out an exhaustive search for regions susceptible to such mechanisms using a combination of transcriptome correlation map analysis and array CGH data for a series of bladder carcinomas. We validated one candidate region experimentally, demonstrating histone methylation leading to the loss of expression of neighboring genes without DNA methylation.

Usage

```
data( PMID17099711.GPL91_eset )
```

Format

```
experimentData(eset):
```

```
Experiment data
```

```
  Experimenter name: Stransky N, Vallot C, Reyal F, Bernard-Pierrot I, de Medina SG, Segraves R, de Rycke
```

```
  Laboratory: Stransky, Radvany 2006
```

```
  Contact information:
```

```
  Title: Regional copy number-independent deregulation of transcription in cancer.
```

```
  URL:
```

```
  PMIDs: 17099711
```

```
  Abstract: A 136 word abstract is available. Use abstract method.
```

```
  Information is available on: preprocessing
```

```
  notes:
```

```
    platform_title:
```

```
      [HG_U95A] Affymetrix Human Genome U95A Array
```

```
    platform_shorttitle:
```

```
      Affymetrix U95A
```

```
    platform_summary:
```

```
      hgu95a
```

```
    platform_manufacturer:
```

```
      Affymetrix
```

```
    platform_distribution:
```

```
      commercial
```

```
    platform_accession:
```

```
      GPL91
```

```
    platform_technology:
```

```
      NA
```

```
Preprocessing: rma
```

```
featureData(eset):
```

```
An object of class AnnotatedDataFrame
```

```
  featureNames: AADAC AAK1 ... ZZZ3 (8948 total)
```

```
  varLabels: probeset gene
```

```
  varMetadata: labelDescription
```

Details

assayData: 8948 features, 31 samples
 Platform type: hgu95a

 Available sample meta-data:

unique_patient_ID:
 Length Class Mode
 31 character character

sample_type:
 healthy tumor
 5 26

summarystage:
 invasive superficial NAs
 17 9 5

T:
 Min. 1st Qu. Median Mean 3rd Qu. Max. NAs
 0.000 1.000 2.000 2.077 3.000 4.000 5

substage:
 a b NAs
 11 4 16

G:
 1 2 3 NAs
 4 7 15 5

N:
 0 1 2 NAs
 20 1 2 8

M:
 0 1 NAs
 20 2 9

gender:
 f m
 7 24

batch:
 Length Class Mode
 31 character character

uncurated_author_metadata:

Length	Class	Mode
31	character	character

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