

CO data analysis

2022-12-21

Import and check data

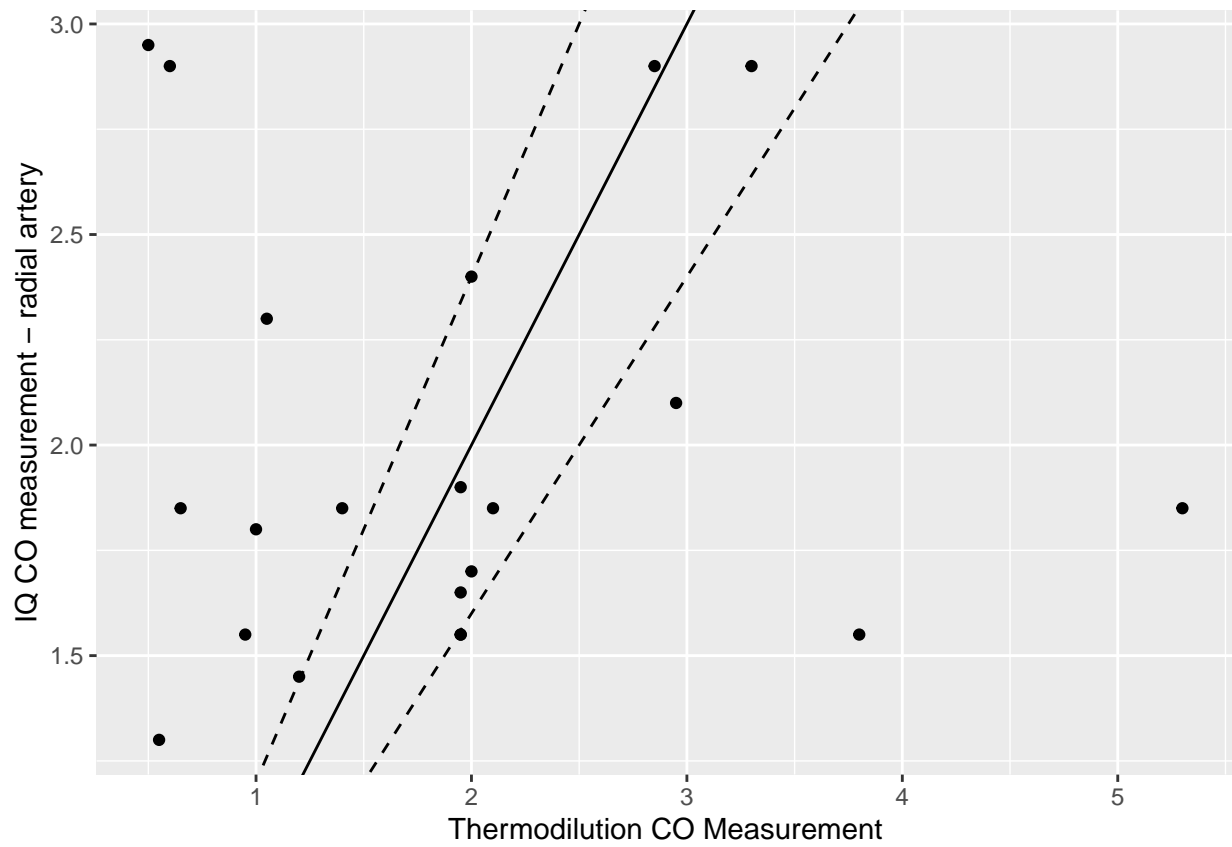
```
## Patient_num time td iq_r iq_m
## 1 1 1 3.70 NA 3.90
## 2 2 1 2.95 2.10 2.05
## 3 3 1 3.30 2.90 4.80
## 4 4 1 1.95 1.55 1.65
## 5 5 1 2.25 NA 1.65
## 6 6 1 1.40 1.85 1.90

## 'data.frame': 32 obs. of 5 variables:
## $ Patient_num: int 1 2 3 4 5 6 7 8 1 2 ...
## $ time : int 1 1 1 1 1 1 1 1 2 2 ...
## $ td : num 3.7 2.95 3.3 1.95 2.25 1.4 3.8 1.2 1.55 0.95 ...
## $ iq_r : num NA 2.1 2.9 1.55 NA 1.85 1.55 1.45 NA 1.55 ...
## $ iq_m : num 3.9 2.05 4.8 1.65 1.65 1.9 2.05 1.45 2.9 2.65 ...
```

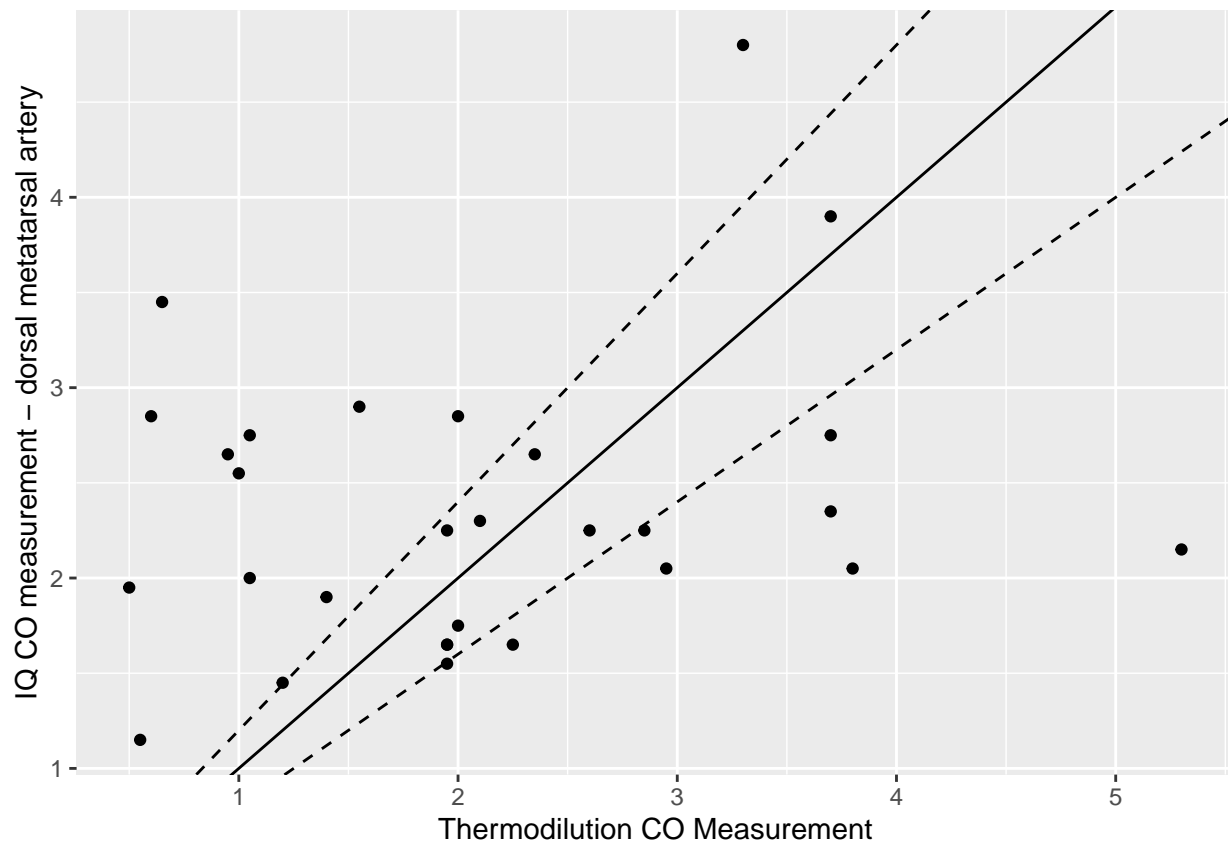
Plot raw data

Dashed lines are 20% variation from unity

```
## Warning: Removed 11 rows containing missing values (geom_point).
```



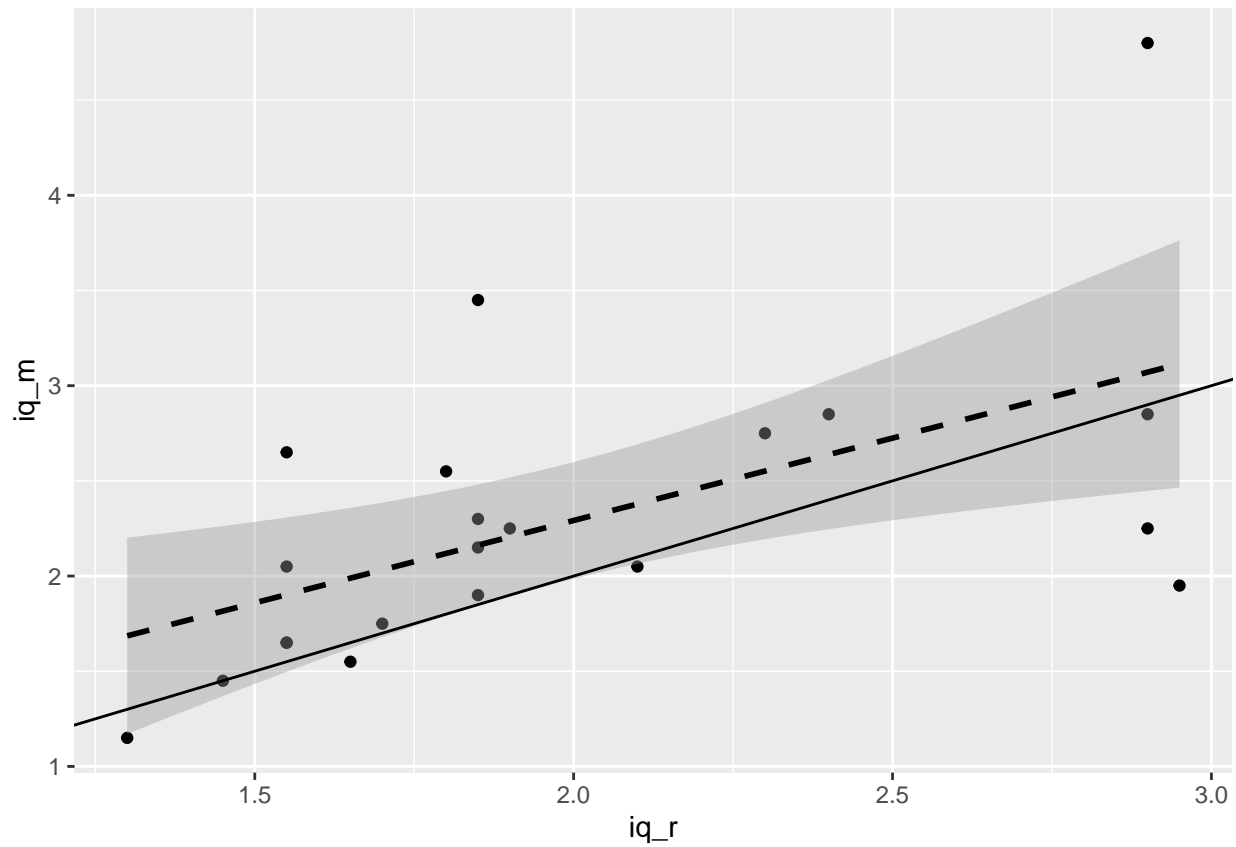
Warning: Removed 3 rows containing missing values (geom_point).



```
## 'geom_smooth()' using formula 'y ~ x'
```

```
## Warning: Removed 11 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 11 rows containing missing values (geom_point).
```



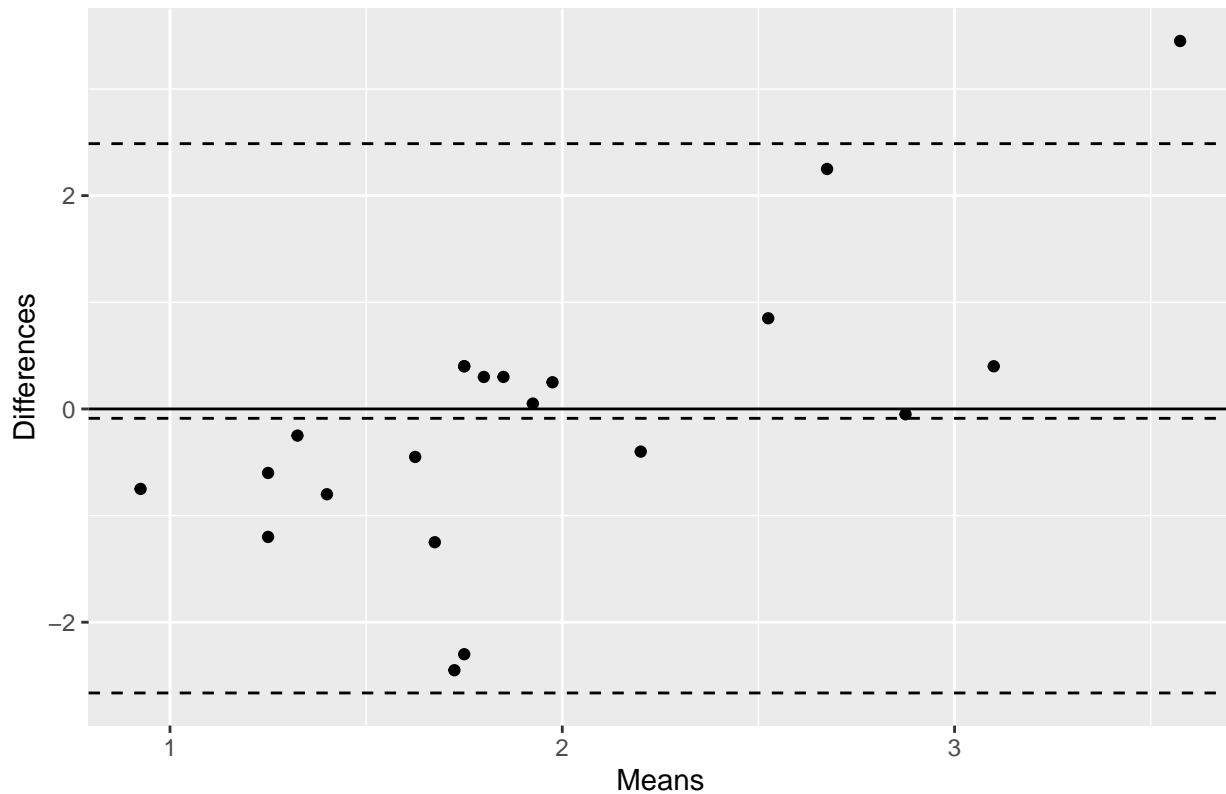
BA analysis for overall data

Radial artery

```
## Warning: Use of 'plot.data$x.axis' is discouraged. Use 'x.axis' instead.
```

```
## Warning: Use of 'plot.data$y.axis' is discouraged. Use 'y.axis' instead.
```

Bland-Altman plot for comparison of 2 methods



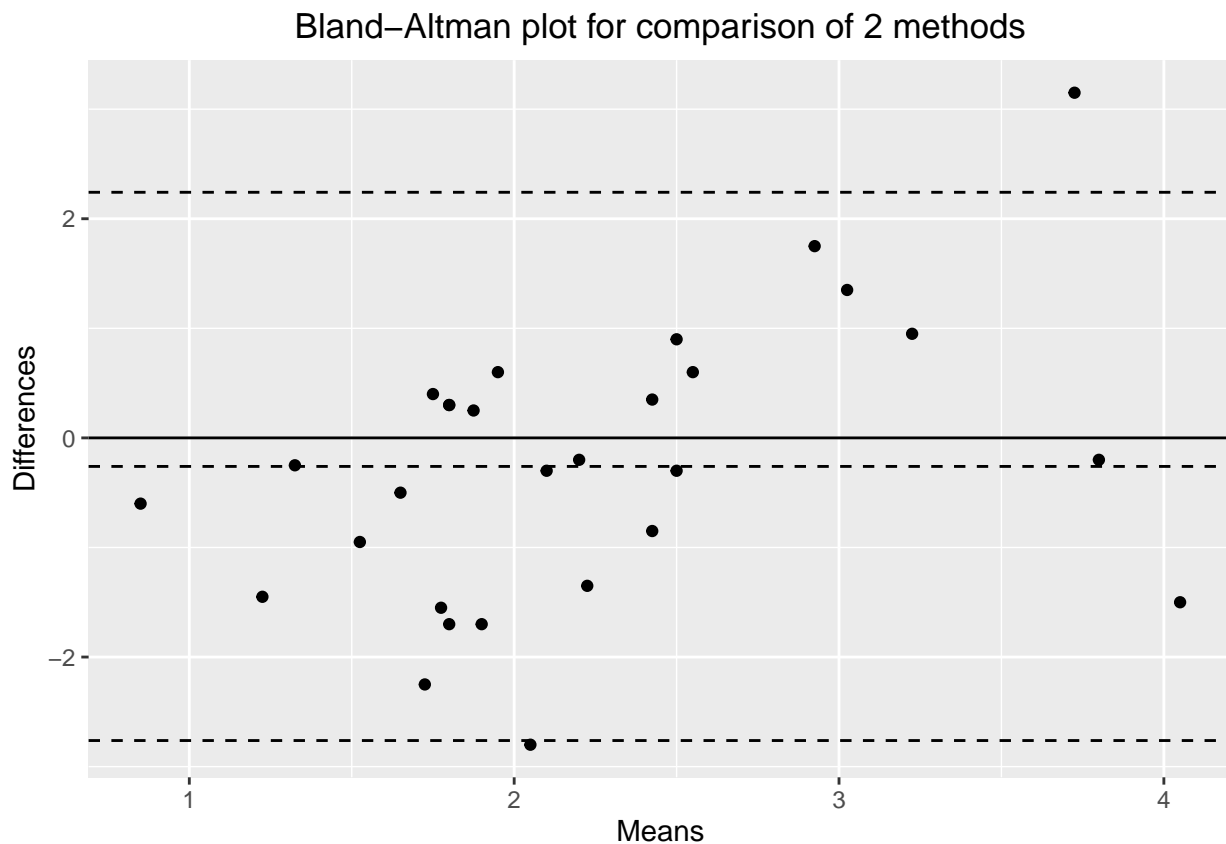
```
## Number of comparisons: 21
## Maximum value for average measures: 3.575
## Minimum value for average measures: 0.925
## Maximum value for difference in measures: 3.45
## Minimum value for difference in measures: -2.45
##
## Bias: -0.08809524
## Standard deviation of bias: 1.31405
##
## Standard error of bias: 0.2867491
## Standard error for limits of agreement: 0.4980499
##
## Bias: -0.08809524
## Bias- upper 95% CI: 0.5100529
## Bias- lower 95% CI: -0.6862434
##
## Upper limit of agreement: 2.487442
## Upper LOA- upper 95% CI: 3.526356
## Upper LOA- lower 95% CI: 1.448528
##
## Lower limit of agreement: -2.663632
## Lower LOA- upper 95% CI: -1.624718
## Lower LOA- lower 95% CI: -3.702546
##
## Derived measures:
## Mean of differences/means: -17.89307
## Point estimate of bias as proportion of lowest average: -9.52381
```

```
## Point estimate of bias as proportion of highest average -2.464202
## Spread of data between lower and upper LoAs: 5.151074
## Bias as proportion of LoA spread: -1.71023
##
## Bias:
## -0.08809524 ( -0.6862434 to 0.5100529 )
## ULoA:
## 2.487442 ( 1.448528 to 3.526356 )
## LLoA:
## -2.663632 ( -3.702546 to -1.624718 )
```

And dorsal metatarsal...

```
## Warning: Use of 'plot.data$x.axis' is discouraged. Use 'x.axis' instead.
```

```
## Warning: Use of 'plot.data$y.axis' is discouraged. Use 'y.axis' instead.
```



```
## Number of comparisons: 29
## Maximum value for average measures: 4.05
## Minimum value for average measures: 0.85
## Maximum value for difference in measures: 3.15
## Minimum value for difference in measures: -2.8
##
## Bias: -0.2603448
## Standard deviation of bias: 1.276391
```

```

##
## Standard error of bias: 0.2370199
## Standard error for limits of agreement: 0.4097996
##
## Bias: -0.2603448
## Bias- upper 95% CI: 0.2251685
## Bias- lower 95% CI: -0.7458581
##
## Upper limit of agreement: 2.241382
## Upper LOA- upper 95% CI: 3.080819
## Upper LOA- lower 95% CI: 1.401946
##
## Lower limit of agreement: -2.762072
## Lower LOA- upper 95% CI: -1.922635
## Lower LOA- lower 95% CI: -3.601508
##
## Derived measures:
## Mean of differences/means: -21.35699
## Point estimate of bias as proportion of lowest average: -30.6288
## Point estimate of bias as proportion of highest average -6.428267
## Spread of data between lower and upper LoAs: 5.003454
## Bias as proportion of LoA spread: -5.203302
##
## Bias:
## -0.2603448 ( -0.7458581 to 0.2251685 )
## ULoA:
## 2.241382 ( 1.401946 to 3.080819 )
## LLoA:
## -2.762072 ( -3.601508 to -1.922635 )

```

Same analysis for initial normotensive state

Radial artery

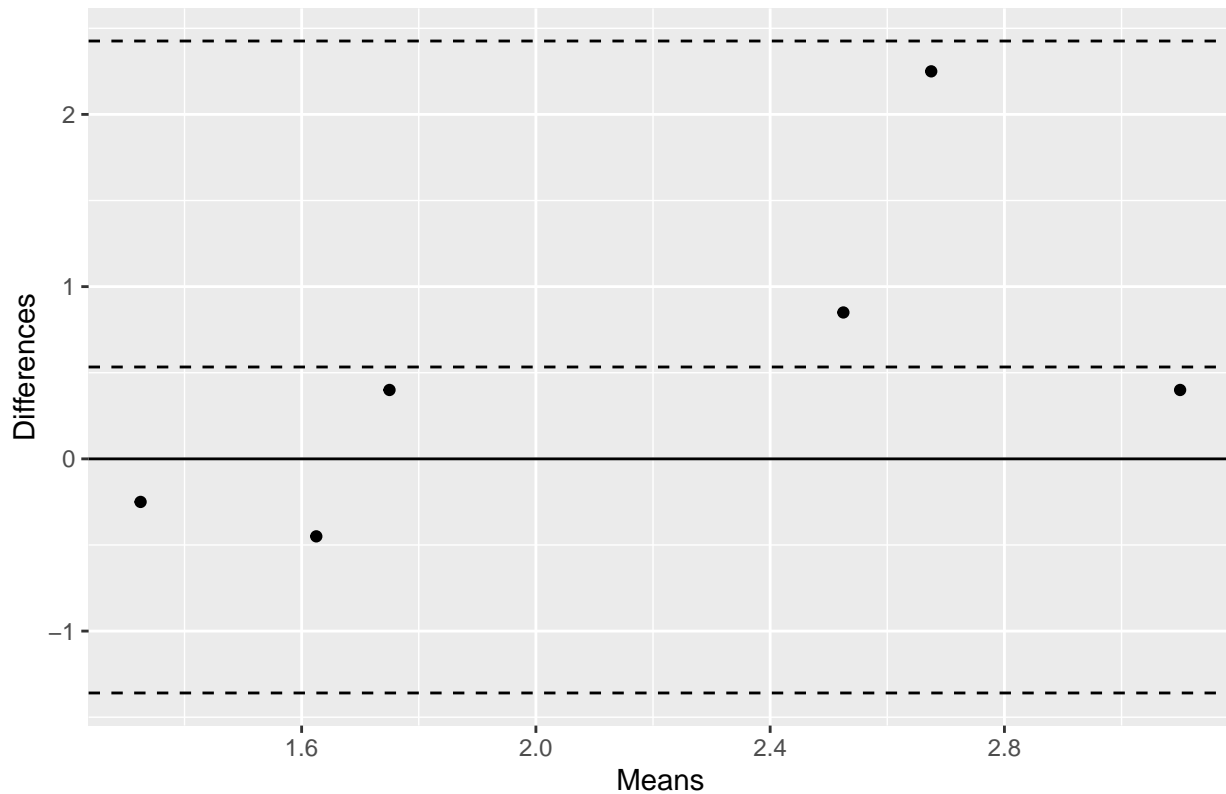
```

## Warning: Use of 'plot.data$x.axis' is discouraged. Use 'x.axis' instead.

## Warning: Use of 'plot.data$y.axis' is discouraged. Use 'y.axis' instead.

```

Bland–Altman plot for comparison of 2 methods



```
## Number of comparisons: 6
## Maximum value for average measures: 3.1
## Minimum value for average measures: 1.325
## Maximum value for difference in measures: 2.25
## Minimum value for difference in measures: -0.45
##
## Bias: 0.5333333
## Standard deviation of bias: 0.9657467
##
## Standard error of bias: 0.3942644
## Standard error for limits of agreement: 0.7167458
##
## Bias: 0.5333333
## Bias- upper 95% CI: 1.546822
## Bias- lower 95% CI: -0.4801557
##
## Upper limit of agreement: 2.426197
## Upper LOA- upper 95% CI: 4.268651
## Upper LOA- lower 95% CI: 0.5837432
##
## Lower limit of agreement: -1.35953
## Lower LOA- upper 95% CI: 0.4829235
## Lower LOA- lower 95% CI: -3.201984
##
## Derived measures:
## Mean of differences/means: 17.82928
## Point estimate of bias as proportion of lowest average: 40.25157
```

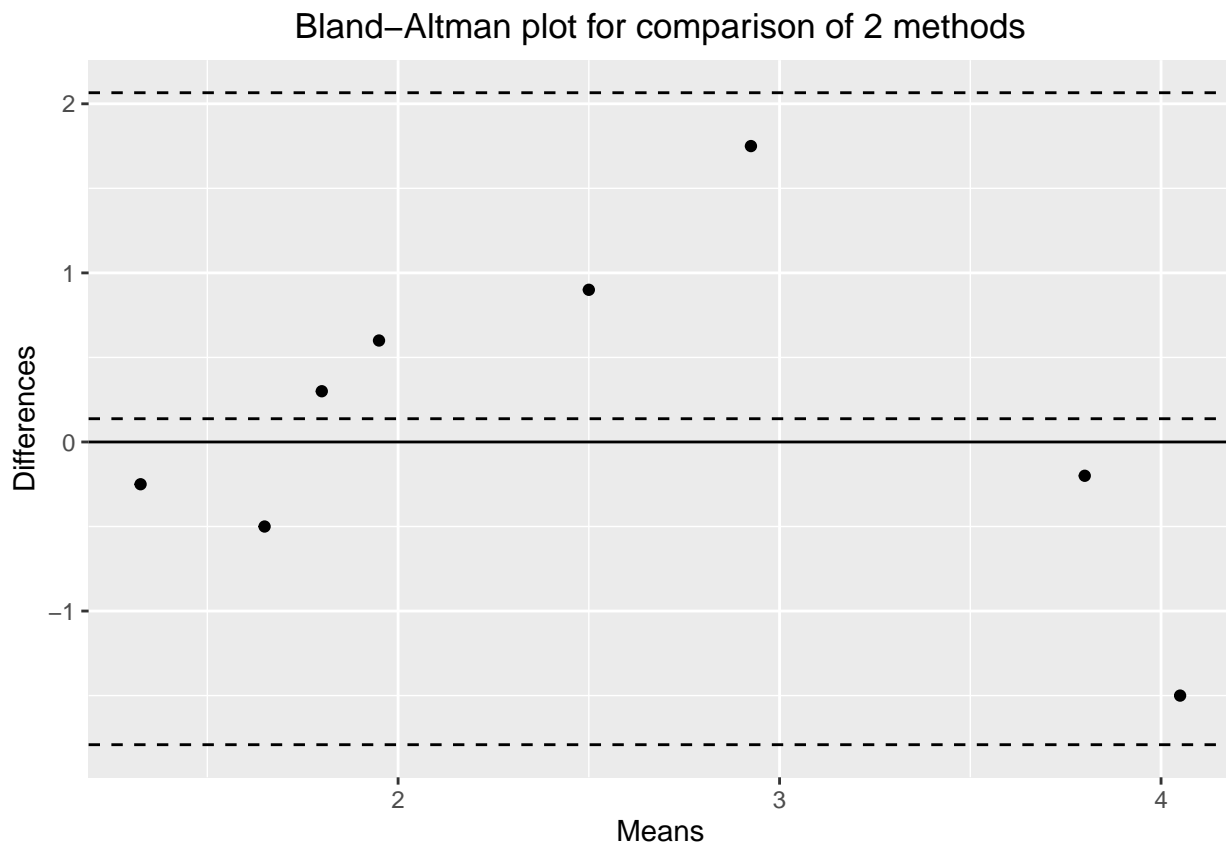


```
## Point estimate of bias as proportion of highest average 17.2043
## Spread of data between lower and upper LoAs: 3.785727
## Bias as proportion of LoA spread: 14.088
##
## Bias:
## 0.5333333 ( -0.4801557 to 1.546822 )
## ULoA:
## 2.426197 ( 0.5837432 to 4.268651 )
## LLoA:
## -1.35953 ( -3.201984 to 0.4829235 )
```

and dorsal metatarsal...

```
## Warning: Use of 'plot.data$x.axis' is discouraged. Use 'x.axis' instead.
```

```
## Warning: Use of 'plot.data$y.axis' is discouraged. Use 'y.axis' instead.
```



```
## Number of comparisons: 8
## Maximum value for average measures: 4.05
## Minimum value for average measures: 1.325
## Maximum value for difference in measures: 1.75
## Minimum value for difference in measures: -1.5
##
## Bias: 0.1375
## Standard deviation of bias: 0.9837065
```

```

##
## Standard error of bias: 0.3477928
## Standard error for limits of agreement: 0.621676
##
## Bias: 0.1375
## Bias- upper 95% CI: 0.9598993
## Bias- lower 95% CI: -0.6848993
##
## Upper limit of agreement: 2.065565
## Upper LOA- upper 95% CI: 3.535595
## Upper LOA- lower 95% CI: 0.5955347
##
## Lower limit of agreement: -1.790565
## Lower LOA- upper 95% CI: -0.3205347
## Lower LOA- lower 95% CI: -3.260595
##
## Derived measures:
## Mean of differences/means: 6.474226
## Point estimate of bias as proportion of lowest average: 10.37736
## Point estimate of bias as proportion of highest average 3.395062
## Spread of data between lower and upper LoAs: 3.85613
## Bias as proportion of LoA spread: 3.565751
##
## Bias:
## 0.1375 ( -0.6848993 to 0.9598993 )
## ULoA:
## 2.065565 ( 0.5955347 to 3.535595 )
## LLoA:
## -1.790565 ( -3.260595 to -0.3205347 )

```

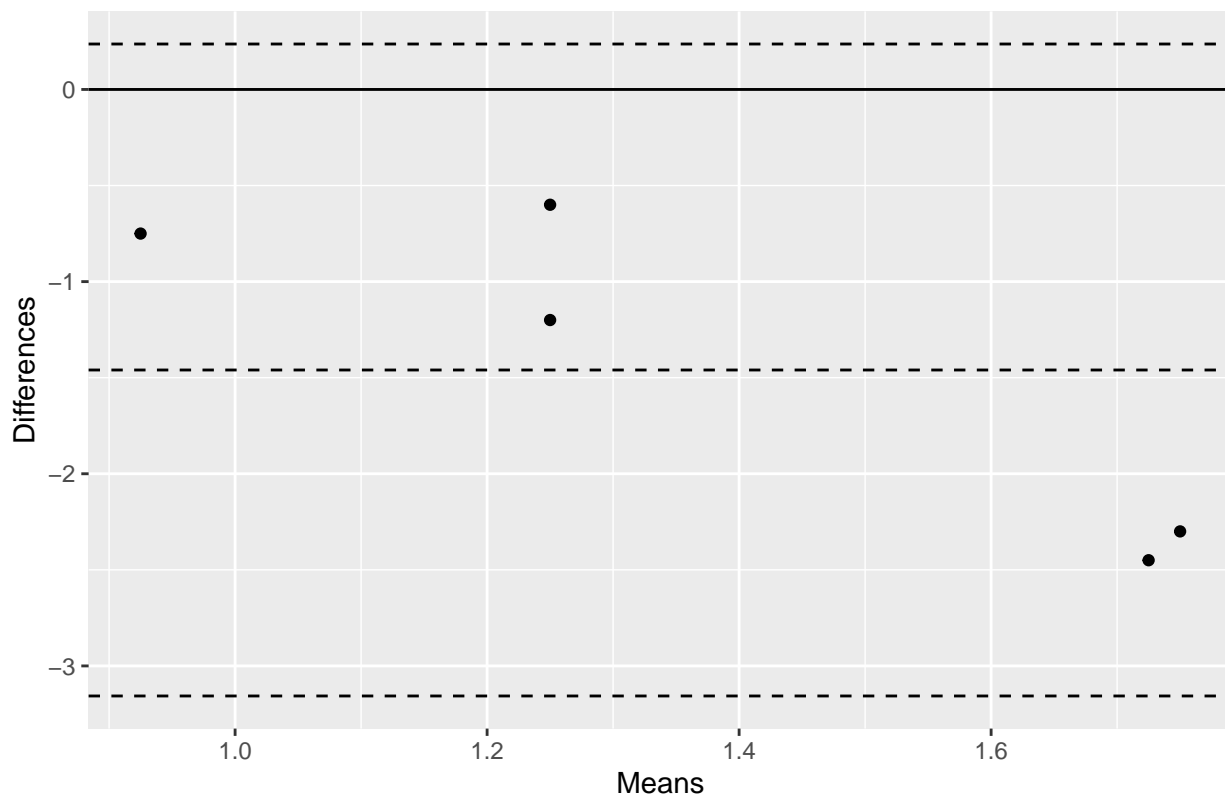
Analysis of hypotensive state (time 2)

radial artery

```
## Warning: Use of 'plot.data$x.axis' is discouraged. Use 'x.axis' instead.
```

```
## Warning: Use of 'plot.data$y.axis' is discouraged. Use 'y.axis' instead.
```

Bland–Altman plot for comparison of 2 methods



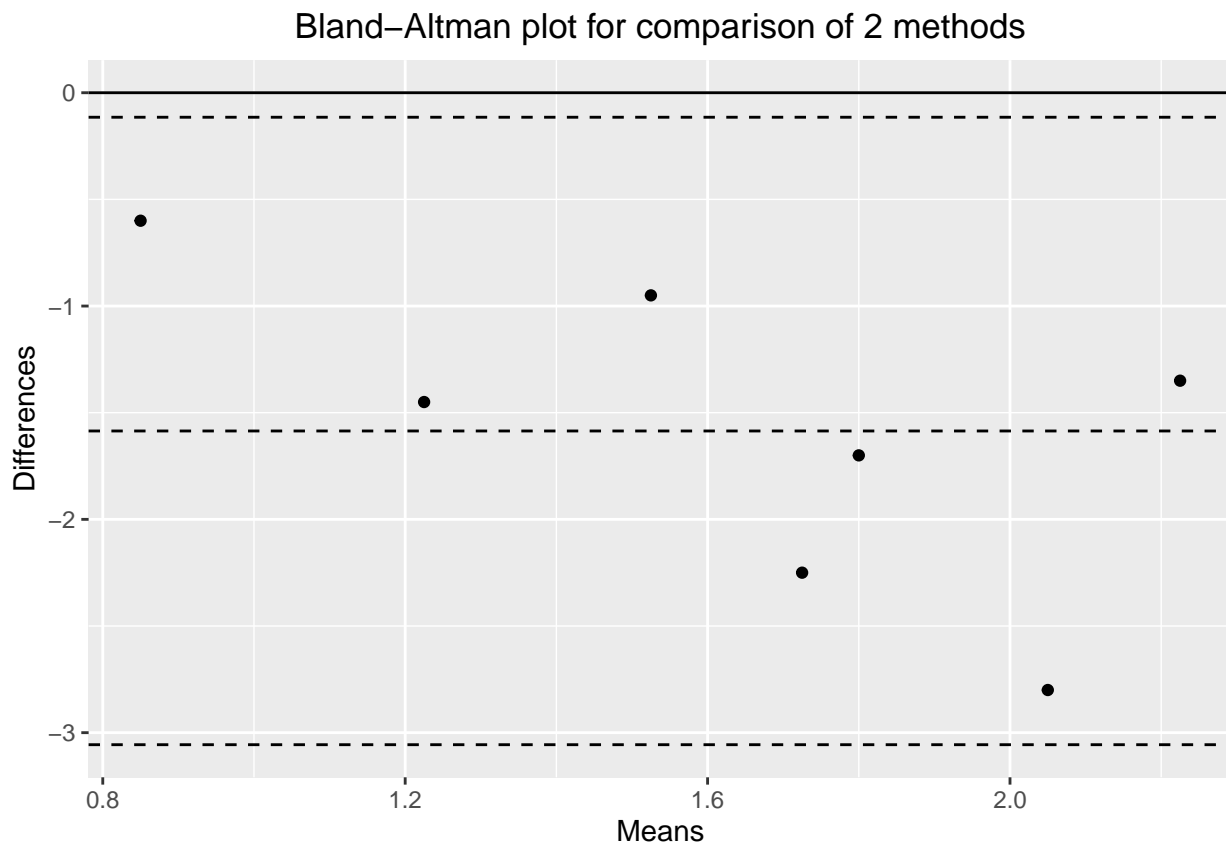
```
## Number of comparisons: 5
## Maximum value for average measures: 1.75
## Minimum value for average measures: 0.925
## Maximum value for difference in measures: -0.6
## Minimum value for difference in measures: -2.45
##
## Bias: -1.46
## Standard deviation of bias: 0.8655923
##
## Standard error of bias: 0.3871046
## Standard error for limits of agreement: 0.7138814
##
## Bias: -1.46
## Bias- upper 95% CI: -0.3852252
## Bias- lower 95% CI: -2.534775
##
## Upper limit of agreement: 0.2365609
## Upper LOA- upper 95% CI: 2.218613
## Upper LOA- lower 95% CI: -1.745492
##
## Lower limit of agreement: -3.156561
## Lower LOA- upper 95% CI: -1.174508
## Lower LOA- lower 95% CI: -5.138613
##
## Derived measures:
## Mean of differences/means: -99.70773
## Point estimate of bias as proportion of lowest average: -157.8378
```

```
## Point estimate of bias as proportion of highest average -83.42857
## Spread of data between lower and upper LoAs: 3.393122
## Bias as proportion of LoA spread: -43.02822
##
## Bias:
## -1.46 ( -2.534775 to -0.3852252 )
## ULoA:
## 0.2365609 ( -1.745492 to 2.218613 )
## LLoA:
## -3.156561 ( -5.138613 to -1.174508 )
```

and dorsal metatarsal

```
## Warning: Use of 'plot.data$x.axis' is discouraged. Use 'x.axis' instead.
```

```
## Warning: Use of 'plot.data$y.axis' is discouraged. Use 'y.axis' instead.
```



```
## Number of comparisons: 7
## Maximum value for average measures: 2.225
## Minimum value for average measures: 0.85
## Maximum value for difference in measures: -0.6
## Minimum value for difference in measures: -2.8
##
## Bias: -1.585714
## Standard deviation of bias: 0.7503967
```

```
##
## Standard error of bias: 0.2836233
## Standard error for limits of agreement: 0.510589
##
## Bias: -1.585714
## Bias- upper 95% CI: -0.8917131
## Bias- lower 95% CI: -2.279716
##
## Upper limit of agreement: -0.1149367
## Upper LOA- upper 95% CI: 1.13443
## Upper LOA- lower 95% CI: -1.364303
##
## Lower limit of agreement: -3.056492
## Lower LOA- upper 95% CI: -1.807126
## Lower LOA- lower 95% CI: -4.305858
##
## Derived measures:
## Mean of differences/means: -96.19849
## Point estimate of bias as proportion of lowest average: -186.5546
## Point estimate of bias as proportion of highest average -71.26806
## Spread of data between lower and upper LoAs: 2.941555
## Bias as proportion of LoA spread: -53.90735
##
## Bias:
## -1.585714 ( -2.279716 to -0.8917131 )
## ULoA:
## -0.1149367 ( -1.364303 to 1.13443 )
## LLoA:
## -3.056492 ( -4.305858 to -1.807126 )
```

Code used to evaluate and graph the data

```
knitr::opts_chunk$set(echo = FALSE)
library(ggplot2)
library(tidyverse)
library(blandr)
codata <- read.csv("co_data.csv")
head(codata); str(codata)
p1 <- ggplot(data = codata, aes(x=td, y=iq_r))
p1 + geom_point() +
  geom_abline(intercept = 0, slope = 1) +
  geom_abline(intercept = 0, slope = 1.2, linetype = "dashed") +
  geom_abline(intercept = 0, slope = 0.8, linetype = "dashed") +
  labs(x = "Thermodilution CO Measurement",
       y = "IQ CO measurement - radial artery")

p2 <- ggplot(data = codata, aes(x=td, y=iq_m))
p2 + geom_point() +
  geom_abline(intercept = 0, slope = 1) +
  geom_abline(intercept = 0, slope = 1.2, linetype = "dashed") +
  geom_abline(intercept = 0, slope = 0.8, linetype = "dashed") +
```

```

labs(x = "Thermodilution CO Measurement",
     y = "IQ CO measurement - dorsal metatarsal artery")

p3 <- ggplot(data = codata, aes(x=iq_r, y=iq_m))
p3 + geom_point() +
  geom_smooth(method = lm, linetype = 'dashed', color = 'black') +
  geom_abline(intercept = 0, slope = 1)
datr <- codata %>% drop_na('iq_r')
blandr.draw(datr$td, datr$iqr, ciDisplay = F)
blandr.output.text(datr$td, datr$iqr)
datm <- codata %>% drop_na('iq_m')
blandr.draw(datm$td, datm$iqm, ciDisplay = F)
blandr.output.text(datm$td, datm$iqm)
datr1 <- codata %>% drop_na('iq_r') %>% filter(time == 1)
blandr.draw(datr1$td, datr1$iqr, ciDisplay = F)
blandr.output.text(datr1$td, datr1$iqr)
datm1 <- codata %>% drop_na('iq_m') %>% filter(time == 1)
blandr.draw(datm1$td, datm1$iqm, ciDisplay = F)
blandr.output.text(datm1$td, datm1$iqm)
datr2 <- codata %>% drop_na('iq_r') %>% filter(time == 2)
blandr.draw(datr2$td, datr2$iqr, ciDisplay = F)
blandr.output.text(datr2$td, datr2$iqr)
datm2 <- codata %>% drop_na('iq_m') %>% filter(time == 2)
blandr.draw(datm2$td, datm2$iqm, ciDisplay = F)
blandr.output.text(datm2$td, datm2$iqm)

```